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**The New Volume of The Electrical World.** THE present number begins the 18th volume of THE ELECTRICAL WORLD, and initiates what we hope will be the largest and most complete record of the electrical work of a half year that has ever been issued. Our last volume was a monument to the electrical activity of 1891, for it contained more matter, and, we trust, better matter, than the previous volume. Four hundred and ninety pages of solid reading matter in a single half year is a record that means something more than editorial activity, for although the task of eliminating things of insufficient importance for the general reader has to be no less assiduously pursued than in the past, the actual amount of activity in electrical research and invention has been something prodigious, and as the summer season begins we shall realize more and more how completely electrical enterprise and electrical industry have captured the last decade of the Nineteenth century.

**The Rapid Transit Commission.** Is it not about time that this eminent body gave some further report on its plans? The preliminary announcement, presented to the public some few weeks ago, was rich in generalities and replete with suggestions of what might be done; but anything like definite plans have as yet failed to materialize. Such a task, of course, cannot be completed in a hurry, but we beg to remind the commission that every month of delay in making some definite recommendations concerning the method of construction to be followed means putting off the hour for which we are all waiting to a period unpleasantly remote. It is no small task at the best, however, but it certainly would seem possible from among all the numerous plans presented to the commission to select one sufficiently feasible for carrying out. The public is impatient for rapid transit, and will not be likely to grow more amiable if after long continued delay there should still be an exhibition of the indecision that may be best characterized as hedging.

**A Conduit Electric Railway.** WE are pleased to hear from Chicago that a rather promising conduit electric railroad is under way in that city. The Fullerton Avenue line is the one selected for equipment on the new system, and work upon it will be begun during the present week. A conduit electric railway has never been given a very exhaustive trial in this country; the late lamented experiments in Boston were so disastrous that the entire method has been distrusted, and it is only recently—more than anything else through the success of the Budapest tramway—that it has been rehabilitated in popular favor. The great success of this latter enterprise, engineered by the well known firm of Siemens & Halske, ought to be an encouragement to other workers in the same field, and we hope that American engineers will not be behindhand in developing this particular line of electrical traction. The Love Company, that is exploiting the road of which we are speaking, has a very straightforward, simple conduit system and a good fighting chance for success. In conclusion we can only remind it, and all other inventors and engineers of electrical conduits, that the point wherein their predecessors have failed is in insulation, and that the greatest care in designing and ceaseless vigilance are the only preventives of this particular difficulty.

**A Thousand Horse Power Dynamo.** ON another page we give a description and cut of what is perhaps the largest dynamo, so far as output is concerned, ever constructed in this country. It is, like several other colossal machines, intended for metallurgical work, its special office being the electrolytic reduction of aluminum. The peculiar features of its design that at once command attention are the absence of any separate commutator, and the unusual construction of the armature. This is built up of very massive bars of drawn copper insulated with mica and asbestos. The brushes rest directly on the surface of the armature between the pole pieces. The output is intended to be, if necessary, as high as 750,000 watts, and normally perhaps half that figure. The electromotive force actually employed will probably not be over 50 volts, though the machine is capable of giving 110 at a reasonable speed. The designer of this dynamo, Mr. T. L. Willson, has as yet given it only a partial test, but enough to show that the requisite electromotive force can be readily developed, and that the losses in the machine are not likely to be severe. Some idea of its great magnitude may be derived from the fact that the pulley by which it is operated is not less than five feet in diameter, while the armature is two feet in diameter and four feet long. We shall await reports of further tests with keen interest.

**The Faraday Centennial.** THE cable dispatch this week contains some further notice of the Faraday centenary. All in all, it was a notable gathering of scientific men, and was enriched with an exhibition of appropriate experiments by the eminent lecturers. The principal lecture was by Lord Rayleigh, the successor of Faraday in the distinguished position of professor in the Royal Institution. This Royal Institution, where the great bulk of Faraday's splendid work was done, is one of the few foundations in the world for the endowment of research. Faraday as professor there was free to exercise his magnificent talents almost untrammeled by the routine work of instruction that has choked more than one scientific man into comparative insignificance. And following Faraday was Tyndall, retired a short time since full of years and honors. The work of these two men would repay a thousand times the paltry burden of supporting the institution, even for the entire period of its history. Few scientific men have been fortunate enough to work with so little of hindrance from irksome professional duties, and the example of the illustrious Faraday and his hardly less eminent successor ought to point out the immense value to civilization of the research laboratory fully equipped and endowed. We are living perhaps in a country too young thoroughly to appreciate the practical value of such an institution, but the time will come when we may not be without a place where investigators of the highest order may pursue their work unchecked by arduous duties and stimulated by the admirable work of those who have gone before them.

**Range Finders for the Navy.** As a result of the recent trials of the dynamite cruiser "Vesuvius" a requisition has been made on the board of ordnance for a set of Fiske range finders. Previous experiments with this ingenious apparatus have given naval officers a great deal of confidence in its successful operation, and while in the case of an ordinary ship's battery its use is a great convenience, in the case of the "Vesuvius" it rises almost to the rank of an absolute necessity. As is probably well known to most of our readers, the guns of the "Vesuvius" are permanently in position in the hull without the power of changing either their elevation or direction except as the ship is moved, and the requisite ranges are obtained by altering the air pressure behind the projectile. On firing the gun the missile rises immediately and describes a very high trajectory, falling downward not in a gradual curve like an ordinary shell, but at a much greater angle, less than that of mortar fire, but still so great that an error in estimating the distance of the object fired at means a miss. If the exact distance of the target can be quickly and accurately found, as is possible with the Fiske range finder, the chances of a hit are, of course, very much increased. In fact the successful use of the gun for anything but the shortest range depends upon a very exact knowledge of the distance. The results obtained in various trials have not been thoroughly satisfactory, and therefore it is doubly important that the range finder should be given an exhaustive trial in connection with the formidable dynamite gun.

**Efficiency of Jet Water Wheels.** IN another column will be found some tests of a peculiar form of jet water wheel that has come into use in California for electrical purposes. It is quite analogous to the well-known successful Pelton water wheel, except in the form of the buckets. These are intended to reflect the water at such an angle to involve the minimum mechanical loss. Perhaps the most interesting part of the test to the electrical engineer is the efficiency curve of the wheel, showing distinctly how admirable an instrument for the utilization of the forces of nature we have in the water wheel. The jet wheel is comparatively an innovation, brought into use very largely by the extraordinary conditions met in mountainous countries. Admirable as is the turbine under ordinary circumstances, it does not seem to be a successful competitor of the jet wheel when working under very heavy heads of water, and consequently where the available fall is measured by hundreds of feet the turbine has been largely displaced. The maximum efficiencies of the two types are the same but each has its special field of operation in which it stands quite unrivaled. The time will probably come when every one of the hundreds of water powers throughout the West will be turned to use for industrial purposes, not a few of them for the operation of electrical industries of one kind or another. In spite of American energy the Swiss appear to have most appreciated the general applicability of mountain streams, and to-day very many little water power stations are scattered about, even in the humblest villages in Switzerland. A few years hence and we hope to be able to say the same of every part of our own country where nature favors the enterprise.

**Carrying Capacity of Wires.** A DIAGRAM that will be appreciated by all who have occasion to do electric wiring will be found on another page. It is the result of experiments by Mr. T. J. Fay, and is intended to show the safe carrying capacity of insulated wires as used under ordinary circumstances. No factor of ordinary applied electricity is so vaguely known as this important information regarding the amount of current that may safely be applied to a given wire. Nearly all the wiring tables give some figures on the subject, but it is very seldom that one finds two of them agreeing. Furthermore, as Mr. Fay justly remarks, the computations are generally made for bare wire, and hence are of comparatively little use under the usual conditions. The diagram given will enable the carrying capacity of wire for any given rise in temperature to be determined at once by inspection, so that there need be no danger of violating the rules of safe wiring through thoughtlessness or ignorance. It is a fact not generally recognized that the ordinary wiring formulæ, from which the size of wire appropriate to a given current and loss of potential is determined, assume that the resistance of the wire remains constant. The result of this implied condition is that if one takes any of the familiar wiring rules and computes the size of conductor required to feed a very large number of lamps at a short distance, the resulting size of wire is far too small to meet the conditions because its radiating surface is not sufficient to take care of the enormous heat generated. Consequently, in anything except the simplest wiring, data on the safe carrying capacity of wires are indispensable, and we have yet to see a more convenient or generally reliable statement of facts than is to be found in Mr. Fay's compact chart.

## Latest Foreign Electrical News.

*(By cable from our own correspondent.)*

LONDON, June 29, 1891.—At the Faraday centenary at the Royal Institution on Friday, Prof. James Dewar exhibited some beautiful chemical researches, and among the brilliant experiments shown was that of liquid oxygen boiling at a temperature of minus 200 degrees Celsius. Another fine experiment, that has recently attracted attention, was that shown by Mr. James Wimshurst, who exhibited an influence machine working as a motor and developing quite an appreciable amount of power. This peculiar reversibility of static induction machines has been known for some time, but Mr. Wimshurst, with his large experience in the construction and operation of that somewhat unmanageable class of apparatus, has been able to show results in a larger and therefore more striking way than any of his predecessors.

There was a preliminary test of the city lighting of London on Thursday last, and the lamps gave general satisfaction. They are enclosed by neatly finished moulded glass panes, and worked well, besides presenting an attractive appearance.

Some further details of the extraordinary interference of the currents from the City & South London Railway with the work at the Royal Observatory at Greenwich have come to hand. The instrument showing the record was a continuous photographic register of earth currents. There are two separate circuits of considerable length, furnished with earth connections by copper plates. At the end of last year unusual disturbances were observed, which soon settled down to a regularity that suggested some particular disturbing cause. By comparing the recorded times of the disturbances with the times of running the trains on the City & South London Railway, the source of the stray currents was immediately found. The nearest earth plate to the railway is 2¼ miles distant, but in spite of this the currents are regularly and continuously visible from 7 in the morning to 11 o'clock at night. The differences of potential registered are, of course, comparatively slight, ranging, however, from a small fraction of a volt to nearly half a volt.

The death of the eminent Prof. Dr. H. J. Weber, of Göttingen, occurred on Wednesday last. Prof. Weber has for more than 20 years been a conspicuous figure in the field of electrical research, and is perhaps best known to practical electricians as the inventor of much ingenious electrical apparatus, and as the author of a great deal of the most important work that has been done on the subject of electrical units. Prof. Weber was a member of numerous learned societies, and had been prominent in every electrical congress of the last decade. Although not specially known from his connection with practical electricity, he has done an immense amount of service to the art by his persistent and steady investigation of the laws of electricity and the methods and instruments for electrical measurements, and in his death the scientific world has sustained a severe loss, while his place as a painstaking, earnest investigator will not soon be filled.

## NEW BOOKS.

THE ARITHMETIC OF ELECTRICITY. By T. O'Conor Sloane, Ph. D. Pp. 138. Ill. Norman W. Henley & Co., New York, 1891. Price, $1.

This little volume is a useful explanation of some of the ordinary and simple computations met in electrical work. It will be useful to that considerable class of readers to whom algebra is a comparatively unknown quantity. This class, it is to be hoped, is on the decrease, but it has rights that deserve to be respected, and Dr. Sloane's book is one that will meet its wants admirably. We must take sharp issue, however, with the author on his statement that the solution of problems by arithmetic, although in some cases more laborious than algebraic methods, gives a better comprehension of the subject. Arithmetical work is almost universally more complicated in reality than algebraic, and generally fails to give any ideas beyond those required for the particular problem in hand. It seldom gives a general grasp of the problem, and it is apt to hide the real facts in a mass of mongrel mathematics that is neither arithmetic nor algebra. Such a simple little book as this, however, with a considerable number of plain rules and good, illustrative examples, has a useful sphere of its own, and will undoubtedly prove helpful to a considerable number of readers.

ELECTRICITY AND ITS RECENT APPLICATIONS. By Edward Trevert. Pp. 346; ills. Lynn, Mass.: Bubier Pub. Co., 1891. Price $2.

So much is constantly being done in the application of electricity, and so many new forms of apparatus are brought out, that it requires the most constant vigilance to keep up with the times. It is, therefore, a no small service to have put before one in a single volume, even if briefly, some of the very recent advances that have been made in electrical practice. This is the special merit of Mr. Trevert's present volume; it contains much matter that is not altogether new, and many cuts that have done service in the various electrical journals, but it does gather together a considerable number of recent electrical improvements, and is thoroughly illustrated with cuts of various pieces of apparatus referred to in the text. The topics covered range through almost all the applications of electricity, and, for the most part, are brought up to date. No attempt is made to enter into long technical descriptions, or to give any details, but simply to present a running account of electricity as we find it about us every day, without going into exhaustive particulars or trying to give a scientific exposition of principles.

BOILER TESTS. By George H. Barrus. Pp. 280. Illustrated. Boston. The author. Gowing & Co., agents. 1891. Price, $5.

No subject has a much closer bearing on the economy of an electric light or power plant than the general condition and efficiency of the boiler room. It is, too, a subject concerning which there is altogether too much apathy among electrical engineers. Not only is the boiler considered too often a rather secondary matter, but the care that is taken of it is frequently of the worst, as good, perhaps, as it gets in any other kind of service, but by no means good enough. Mr. Barrus is well known as a most accomplished steam engineer, and in the present volume gives the results of no

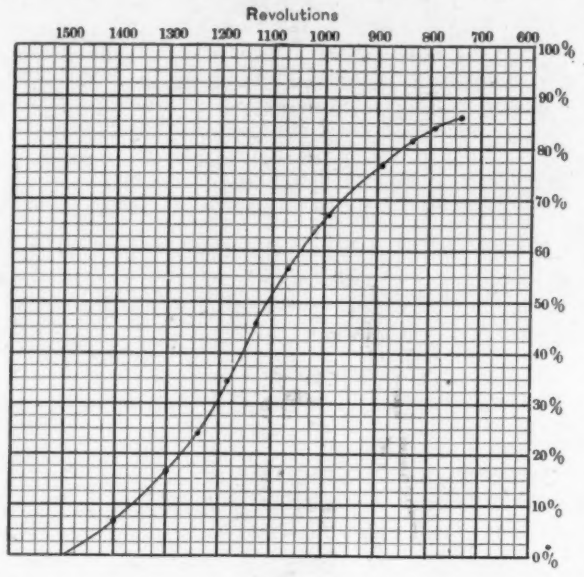



FIG. 1.—CURVE OF EFFICIENCY OF A DODD WATER WHEEL.

less than 137 evaporative tests made by him on 71 boilers; every test teaches its lesson of boiler construction, of furnace arrangement and of care in firing. Boilers good, bad and indifferent are included in the list, as shown by the coal consumption per pound of water evaporated, ranging from 6.8 to as high as 13 pounds. The boilers were of every sort of construction—plain cylinders, vertical tubular, horizontal return tube, and water pipe—and the fullest details as to the fuel, performance of furnaces, temperature of waste gas and similar data are given in convenient form for reference. Altogether it is a book that will bear studying by those who have occasion to put in steam plants for any purpose whatsoever.

## Electric Lighting by Water Power.

The Pacific Wenstrom Electric Company recently installed an electric lighting plant at the Geysers Hotel in Sonoma County, California, which possesses some points of interest. A 24-inch water wheel was used under a head of

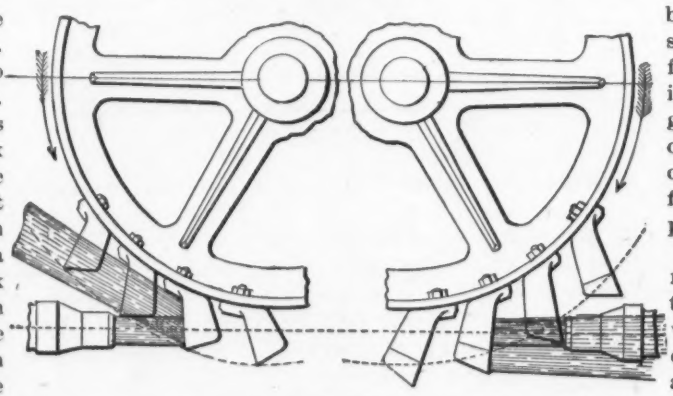


FIG. 2.—TWO METHODS OF CONSTRUCTING WATER WHEEL BUCKETS.

158 feet with a one-inch nozzle, no governor being used on the wheel. A Wenstrom dynamo capable of furnishing current for 100 lights of 16 c. p. each was used to generate the current. The total number of lights wired was 60. The plant is located near the bottom of a deep ravine about 100 yards from the hotel. The curve of efficiency of the Dodd water wheel, shown in Fig. 1, was carefully mapped out, and used as a guide for over-compounding the dynamo, and the results obtained are somewhat remarkable. When the water gate was wide open readings were taken which showed the following results: 60 lights, 750 revolutions, voltage at dynamo, 111; 30 lights, 910 revolutions, voltage at dynamo, 108; 1 light, 1,060 revolutions, voltage at dynamo, 106.

The voltage at the hotel was practically constant. When the brushes were removed from the commutator the speed of the dynamo ran up to about 1,200. In the operation of the plant the water is turned on at about six o'clock, and the oil cups filled, and no further attention is given to the plant until it is shut down at about one o'clock, after seven hours' continuous running. The normal speed of the dynamo was 950 revolutions, but over-compounding brought the full load speed down to 750.

The wheel used in this plant was recently described by Mr. C. T. Ryland, Jr., vice-president and general manager of the above-named company, in a paper read before the California Electrical Society. The reason of the high efficiency of this type of wheel was explained by Mr. Ryland to be due to the shape of the buckets. The feature of the new bucket consists in curving the corners of the bucket down, so as to partly surround the nozzle. The effect is that the water is discharged below the line of impact. With other wheels, the water is discharged upward toward the axis of the wheel, and interferes with the succeeding buckets. Fig. 2 shows the difference of discharge as shown by a photograph taken with the wheels held from rotating. On the right-hand side is shown the new bucket, which discharges most of its water through the lobes of the bucket, and at a point furthest from the axis of the wheel.

## Disparity in Prices of Electric Lighting.

BY H. W. FRUND.

One of the prime causes for the diversity in prices of municipal, commercial and other electric lighting is in the total lack of knowledge and the false reasoning in regard to the cost of production and distribution in localities where widely different conditions arise. Invariably it may be said that in cities and towns, particularly those under 10,000 population where as yet no electric plant has been installed, a wise committee of men knowing nothing whatever of electrical matters, but otherwise of good sense and business tact, are selected from among those who are desirous of taking stock in an electrical company, and at once a junketing trip or tour of inspection is begun, and perhaps a few letters of inquiry are sent out for "your prices of lighting," on which to base the new corporation's charges for lighting. It seems strange that these very men who, desiring aid at law or in the erection of a business block, would not pay counsel or architect fees to a blacksmith or cobbler or even consult with them, will yet, chiefly of their own accord, pursue a more disastrous course in the electric problem and undertake to solve the question as to what system is best suited for their locality and fix prices perhaps by averaging those of a few places as near their population as can be found. The consequence in the majority of cases is more capital expended than would have been otherwise required, prices of lighting fixed that are inadequate, resulting in no earnings, indifference of investors as to increasing their plants, and lack of confidence in general in the public, and always demoralizing to those companies having fair and legitimate prices for lighting in other places. The same may be said of bright aldermen who have axes to grind and wish to show wonderful things to their constituents in the installation and management of municipal plants for city lighting, who manage adroitly to charge labor and other items of expense to street, water and other accounts. Take up a list of central electric stations and look at the various prices for lighting received; it is certainly appalling, and the assignments and total failures noted from time to time are not to be wondered at.

If persons who are ignorant of the electrical business, but who desire to take it up as an investment, would consider one question alone, namely, the prices for the next form of illumination, gas, and conclude to furnish their incandescent light at the same price per thousand feet of gas, they could not go far amiss. If after six months' or one year's experience the rate fixed proves to be too high it can be materially lessened. It is very easy to reduce rates for lighting, but always a serious, difficult and almost impossible matter to increase them.

It is an every-day occurrence to meet investigating committees who know nothing about electrical matters trying to fathom what are called the mysteries of ohms, ampères, volts, watts, etc., when if they would ascertain the price charged in their immediate locality for 1,000 feet of gas, and then conclude that inasmuch as the incandescent lights are clean, steady, not vitiating to the air and for many other reasons the better form of illumination they would charge for this light the same rate as gas. That is to say, if one gas burner will consume five feet of gas per hour, burning 200 hours it would consume 1,000 cubic feet of gas; now as one 16-c. p. incandescent lamp is equal to one five-foot gas burner burning 200 hours would equal 1,000 feet of gas. Also, for instance, if gas is charged at the rate of $2 per 1,000 feet it would make a five-foot burner cost one cent per hour; hence the price of one 16-c. p. incandescent lamp would be one cent per hour. Where watt meters can be used, it has been found that an incandescent lamp consuming 1,000 watt hours of electrical energy will give about one-tenth of the illumination given by 1,000 feet of gas under ordinary circumstances, and if gas is charged for at the rate of $2.50 per 1,000 feet, a customer using electric lights will get the same illumination, to say nothing of the many other advantages of electric light over gas light, if the electricity is charged to him at 25 cents per 1,000 watt hours.

Now, if from experience it is found that a fair return can be had to charge for incandescent light at the rate of

1 for 1,000 feet of gas, a charge can be made of one-half cent per lamp of 16 c. p. per hour, or 10 cents per 1,000 watt hours, etc.

The question is asked daily by parties investigating in regard to the prices of lighting, and often they fix their own rate without knowing the reasons for doing so, and at the same time wholly eliminating the conditions different from their own locality and which go to make up the cost of operating electric plants. A basis for prices of arc lighting can also be had with as great ease, and yet in this line of lighting as great an unwarranted disparity in price prevails.

It is of record in Martinsville, Ind., a town of 3,500 population, where the electric plant is owned by the town corporation, that for the year 1890 20 arc lamps were furnished to stores for $50 per annum each—total, $1,000 received—and 10 arc lamps upon the streets for public lighting, and the total expense of the plant to the town for one year was only $1,265, the cost of the said 10 lights in the streets to the town being only $265, or $26.50 per lamp per year. From these figures it costs apparently very little to produce 2,000 candle power lights—at least it looks nice upon paper; but when the chairman of the committee who proudly presented his figures upon the management of the lighting problem to his constituents was asked by a practical man what the plant originally cost it was found to be $5,000. Taking the $265 for the 10 lamps one year, adding $250, being 5 per cent. interest upon capital invested, then 10 per cent. for depreciation and saying nothing about repairs, supplies, etc., which follow rapidly after a year or two in every new plant, we have $1,015. It was also found that the moon table to midnight, 26 nights in each month, was followed for the street-lighting, which is less than 1,200 hours per year. Now, 1,200 hours into $1,015 makes $101 per lamp per year, or $8\frac{5}{12}$c. per lamp per hour. Quite a difference from $26.50 per lamp per year.

The consequence follows necessarily that the information procured by committees not practical in their investigation is misleading and results are disastrous. These are but a few illustrations of the radical differences in rates for public as well as private lighting, and the causes of failures that might otherwise have been far different.

It is frequently found that where private corporations have fair public lighting contracts, the cost of operating the commercial part after deducting receipts therefor is so unequal compared with the earnings for street lighting that a drain is made continuously upon the revenues from the city to keep up the plant as an entirety, resulting in a bare existence without net earnings, to say nothing of a surplus. It is also found that prices for commercial lighting from dusk to midnight will be for candle power on the basis of 80 cents per thousand feet of gas, when it should be $1.25 or $1.50 per thousand feet, and yet be cheaper than gas. After midnight the rate will be as low as 20 cents per thousand feet of gas, and yet when attention is called to the fact of the cost of the production then it is realized why the city contracts do not pay.

It can also be said that one of the reasons that some cities undertake to furnish their own lighting is because a leading alderman will state to his colleagues the low prices prevailing here and there where cost of operating is no greater than in their own vicinity, and will cite perhaps an item similar to the following, which appeared in nearly all electrical journals about two months ago: "Mt. Carmel, Ill., has contracted for 30 arc lamps of 2,000 nominal candle power all night and every night in the year for $1,800 per year."

On the strength of this item, in another place where competition was asked for public lighting a reasonable bid for good service was wholly rejected. Upon investigation of the Mt. Carmel matter it was found that the item published was correct, but that the contractor had undertaken what he could not do, forfeited his security, and the town is again at the expense of advertising for bids. Now, while here is an instance of a contract being forfeited, how many companies are there that of their own accord undertake more difficult tasks with results as before stated? That this unwarranted difference in prices may become more uniform and within reason and common-sense, it would seem that parent companies, which have the experience, should advise and undertake to fully inform themselves of the conditions arising where plants are being sold, and suggest the rates of lighting, leaving the new companies an opportunity to reap experience and thereafter reduce their rates if consistent with good management.

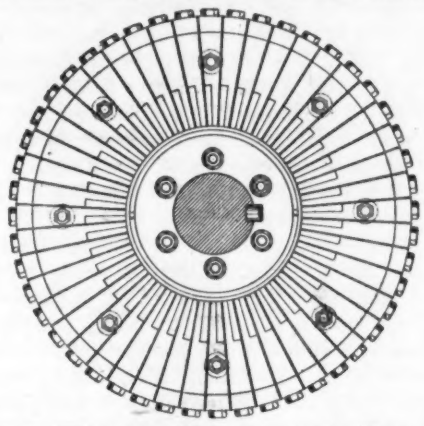
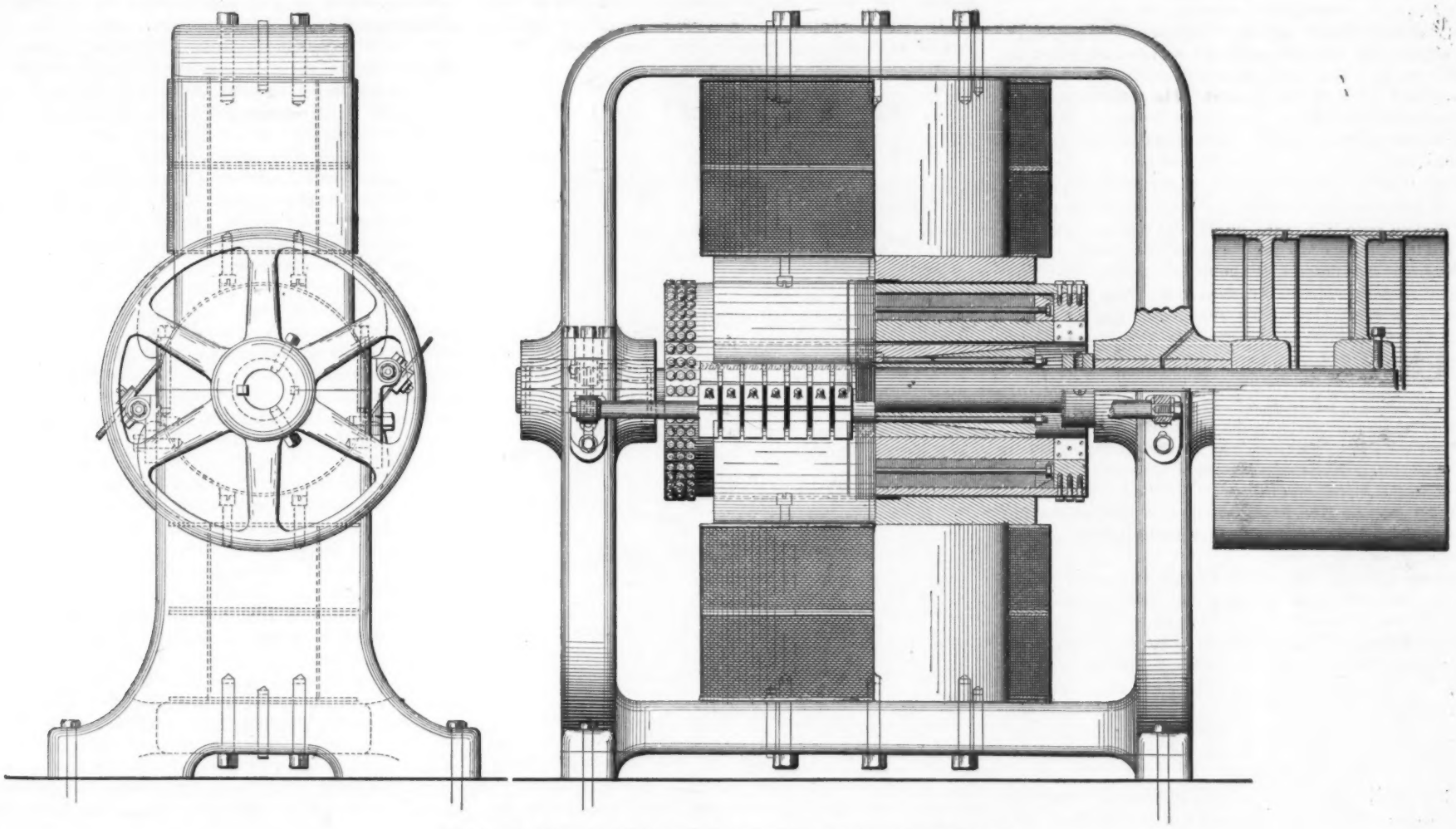


FIG. 1.—WILLSON'S ELECTROPLATING DYNAMO.



FIGS. 2 AND 3.—WILLSON'S ELECTROPLATING DYNAMO.

## A Colossal Dynamo.

In spite of the recent marked tendency toward the construction of very large machines for electric light and power service it must not be forgotten that a dynamo for metallurgical work can hold its own in imposing size and in interesting engineering details. Several monsters of this class have been constructed by various companies and for various uses, but perhaps the largest turned out in this country has just been completed for the use of the Willson Aluminium Company, of 140 Broadway, this city, which has been recently tested at the works of the Brady Manufacturing Company, Brooklyn, where the armature was constructed and wound—if wound be an appropriate word for the process of building up the great cross conductors in the armature. The machine is unusual, not only in size but in general construction. As a glance at the cuts will show it is a partially iron-clad type not very unlike some of the large early Gramme machines. The massive iron work of the frame was itself an immense task to complete, but the work was successfully accomplished after a considerable length of time by W. Taylor & Son, of 23 Adams street, Brooklyn. The frame of the machine consists of two enormous castings with salient pole pieces having wrought-iron cores, both above and below the armature. The armature itself is 24 inches in diameter and 47 inches long, and is of the Gramme construction, formed upon a five-inch hammered steel shaft resting in composition bearings 15 inches long. The armature alone without the pulley weighs 6,163 pounds, while the frame contains 11,000 pounds of castings and 7,000 of solid forgings. As the machine stands with its present pulley it weighs a little less than 30,000 pounds.

The whole machine was designed by Thomas L. Willson, secretary and treasurer of the company, and it was constructed for the purpose of being used in the company's aluminium works. Perhaps the most unique feature of this dynamo is the armature. It is a Gramme ring with armature conductors formed of solid drawn copper, with a cross section of three square inches; the bars upon the periphery are rigidly bolted in place and insulated from each other, but no attempt whatever is made to insulate the surfaces; in fact, the brushes are made to bear directly upon it, thus forming a gigantic commutator of the outer conductors of the armature. This enables a large number of massive brushes (14) as shown in the figure to bear firmly upon the conductors and take off a current so great that it could hardly be handled otherwise. The brushes are distributed along the length of the armature in neutral space, and are all separately movable and adjustable. The insulation used is asbestos and mica, the latter exclusively where the brushes bear, and it will thus be seen that the armature is practically fireproof; at least it is not likely to be damaged by currents any less than those sufficient to melt the massive bars. The pulley that drives the armature is 36 inches in diameter by 26 inch face, but during the recent trial it appeared that even this pulley was of unnecessarily small diameter, and consequently the machine as used will have a five-foot pulley of 26 inch face as before. During this trial the machine with its field separately excited gave 25 volts at 130 revolutions, and consequently would generate 110 volts at less than 550 turns per minute. The capacity in ampères is very great, as may be imagined from the great size of the conductors, and the designer estimates that the machine will rise to an output of 750,000 watts if necessary. During the test recently made no heavy current was drawn from the machine, but when running on open circuit the heating of the armature was so slight as to render it evident that Foucault currents and hysteresis were not formidable factors in its general efficiency. Later, when an adequate load can be secured, the dynamo will be put to a more thorough test, and its full capacity will be determined. It is rather singular that this phenomenally large machine should be made in the two-pole form, but its designer is convinced that his task was thus rendered more simple, and that for the voltage desired his plan of construction was preferable to any multipolar arrangement. Altogether, the machine is a most extraordinary one, and we shall await with the keenest interest the accounts of the further tests to which it will probably soon be put

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## Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1700.——Bernoulli (John I.), son of Nicolas, the founder of the celebrated family of that name, improves upon Picard's discovery of the electrical appearance of the barometer, made A. D. 1675, by devising a mercurial phosphorus or mercury shining in vacuo ("Diss. Physica de Mercurio Lucente, etc.," Basil, 1719). This procured the favorable notice of King Frederick I., of Prussia, who rewarded him with a medal. John Bernoulli I. (1667–1748) was a member of nearly every learned society of Europe and "one of the first mathematicians of a mathematical age." His exceedingly valuable memoirs, found in all the scientific transactions of the day, were first collected in their entirety during the year 1742, by Cramer, professor of mathematics, and published at Lausanne and Geneva.

"Is it not surprising," remarks Professor Robison, in his able article on "Dynamics" (eighth "Britannica," vol. VIII, p. 363), "that, 25 years after the publication of Newton's 'Principia,' a mathematician on the Continent should publish a solution in the Memoirs of the French Academy, and boast that he had given the first demonstration of it? Yet, John Bernoulli did this in 1710. Is it not more remarkable that this should be precisely the solution given by Newton, beginning from the same thorem, the 40th I., Prin., following Newton in every step and using the same subsidiary lines? Yet, so it is." This was five years after he had accepted (1705) the chair of mathematics made vacant by the death of his brother, James I. (1654–1705).

BERNOULLI FAMILY.

The Bernoulli family is as well known in the history of mathematics, by the distinguished services of eight of its members, as is the Cassini family through the successes achieved by four of its representatives in the development of astronomical studies.

Daniel Bernoulli (1700–1782), second son of John I., constructed a dipping needle, which is described at page 85 of the eighth "Britannica," vol. XIV., and with which he observed the dip to diminish half a degree during an earthquake in the year 1767. Before Daniel was twenty-four years old he had declined the Presidency of the Academy of Sciences at Genoa, and, at the age of twenty-five, was appointed professor of mathematics at St. Petersburg.

John Bernoulli II. (1710–1790), youngest of the three sons of John I., gained three prizes from the French Academy of Sciences for Memoirs on the Capstan, on the Propagation of Light and on the Magnet.

John Bernoulli III. (1744–1807), grandson of John I., took the degree of Doctor of Philosophy at the age of thirteen, and, when nineteen years old, was appointed Astronomer Royal of Berlin. He published several volumes of travels, in one of which he relates (A. L. Ternant, "Le Télégraphe," 1881, p. 32) that he saw, in the last-named city, an instrument constructed of five bells, with which all letters of the alphabet could be expressed.

James Bernoulli I. (1654–1705), brother of John I., while at London, was introduced into the philosophical meetings of Boyle, Hooke, Edward Stillingfleet and other learned and scientific men. He opened, in 1682, the *Collegium Experimentale Physico-Mechanicum* for public instruction, but his lasting fame dates from the year 1684, when the great Von Leibnitz published his treatise "De Gravitate Ætheris." Three years later, in 1687, James occupied the mathematical chair of the University of Basel, vacant by the death of the learned Megerlin.

See Whewell, "Hist. of the Inductive Sciences," 1859, vol. I., pp. 358–366, 375–380, 393, 430, and vol. II., pp. 32–39, 42.

A. D. 1700.——Morgagni (Giovanni Battista), while practicing medicine at Bologna and at Venice, uses the magnet to remove particles of iron which had accidentally fallen into the eyes, exactly in the same manner as Kirkringius and Fabricius Hildanus had done before him.

See Maunder's "Biog. Treasury"; also Beckmann's "History of Inventions," vol. I., p. 44, and biography in Larousse, vol. XI., as well as in vol. XVI. of the ninth "Britannica."

A. D. 1700.——Duverney (Joseph Guichard), an eminent French anatomist, knew at this date that the limbs of a frog are convulsed by the electric current (as shown in the "Histoire de l'Académie des Sciences," 1700, p. 40, and 1742, vol. I., p. 187), and the Italian physician L. Marco Antonio Caldani, assistant to Morgagni, alludes to the "revival of frogs by electrical discharges." See also "Ency. Metrop.," vol. IV., p. 220; Highton's "Elect. Tel."; Fahie, "Hist. of Elec. Tel.," pp. 175 and 176 and notes; Knight's "Mech. Dict." vol. II., p. 936.

A. D. 1701–1702.——Le Brun (Pierre), publishes his "Histoire Critique des Pratiques Superstitieuses," wherein he makes mention (vol. I., p. 294) of the possibility of transmitting intelligence in the manner indicated by the Jesuit Leurechon.

A. D. 1702.——Marcel, Commissioner of the Navy at Arles, publishes a pamphlet dedicated to the King, and entitled "The Art of Making Signals, both by Sea and by Land," wherein he affirms that he has "communicated frequently at the distance of two leagues (in as short a space of time as a man could write down and form exactly the letters contained in the advice he would communicate), an unexpected piece of news that took up a page in writing.' The particulars of this invention are, however, wanting.

Marcel reports many well-authenticated instances where, as already mentioned by Julius Cæsar (A. D. 1590), iron bars have become temporarily magnetic by position alone.

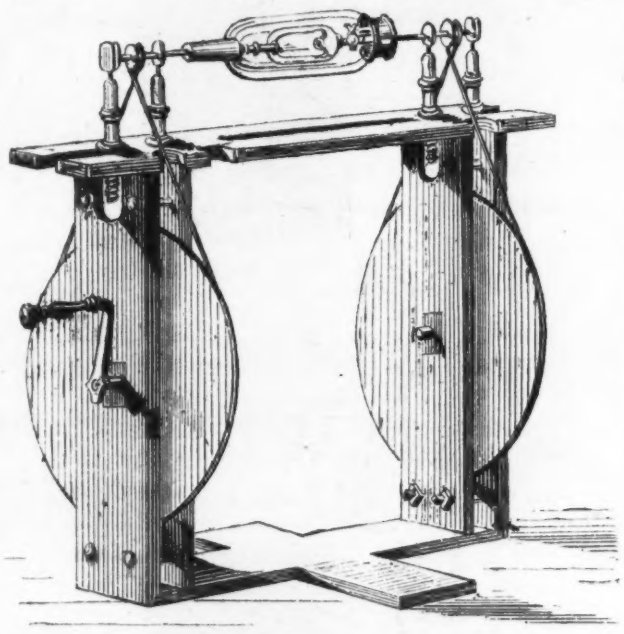
See Snow Harris, "Rudim. Mag.," I. and II., pages 91, 92; also "Emporium of Arts and Sciences," 1812, vol. I., p. 301.

A. D. 1702.——Kaempfer (Engelbrecht), German physician, describes in his "Amænitates Exoticæ," experiments made by him upon the electric torpedo (Leithead, 1837, chap. XII.). He insists that any person may avoid all sensation of the shock by merely holding the breath while touching the animal. This apparently improbable fact has since been confirmed, however, by many scientists; the accurate observations of Mr. Walsh (A. D. 1773) on the subject, reported in the *Phil. Trans.* for 1773–1774–1775, claiming especial attention.

A. D. 1704.——Amontons (Guillaume), an ingenious mechanician and scientist, exhibits before the royal family of France, and before the members of the Académie des Sciences, his system of communicating intelligence between distant points through the agency of magnifying glasses—telescopes. The "Mémoires de l'Académie," 1698–1705, contain an account of his many scientific productions.

A. D. 1705.——Witson (Nicholaes), Burgomaster of Amsterdam, announces at page 56 of his "Noord en Oost Tartarye," that the nautical compass was in use by the Coreans in the second half of the 17th century.

A. D. 1705.——Hauksbee (Francis), English natural philosopher and Curator of the Royal Society, makes, before the latter, several experiments on the *mercurial phosphorus*. He shows that a considerable quantity of light can be produced by agitating mercury in partly exhausted as well as in thoroughly exhausted glass vessels. When



HAUKSBEE'S ELECTRICAL MACHINE AS SHOWN IN HIS "PHYSICO-MECHANICAL EXPERIMENTS."

the mercury is made to break into a shower, flashes of light are seen to start everywhere "in as strange a form as lightning."

He also showed light *in vacuo* produced by rubbing amber and also by rubbing glass upon woolen. He says (Priestley, "Hist. and Present State of Electricity," London, 1775, p. 19) that every fresh glass first gave a purple and then a pale light, and that woolen, tinctured with salt or spirits, produced a new, strong and fulgurating light.

Hauksbee constructed a powerful electrical machine wherein the Von Guericke sulphur globe was replaced by one of glass, as had already been done by Sir Isaac Newton (A. D. 1675). With it he found that upon exhausting the air, whirling it rapidly and placing his hand upon the outside, a strong light appeared upon the interior, and that the light would show itself also upon the outside when air was let into the globe. ("Physico-Mech. Exp.," pp. 12, 14, 26, 32, 34.)

The machine, which the celebrated mechanician Leupold had constructed at Leipsic for Mr. Wolfius, only differed from the original one made by Hauksbee in that the glass globe turned vertically instead of horizontally.

Other experiments with coated glass globes, globes of sulphur, etc., are detailed in the "Physico-Mech. Exp.," as indicated at pages 21–24 of the Priestley work above alluded to. At the last-named page he says: "That Mr. Hauksbee, after all, had no clear idea of the distinction of bodies into electrics and non-electrics appears from some of his last experiments, in which he attempted to produce electrical appearances from metals, and from the reasons he gives for his want of success in those attempts."

Hauksbee also gave some attention to the study of the laws of magnetic force, and the results published in the *Phil. Trans.*, 1712, vol. XXVII, giving a law of force varying as the sesqui-duplicate ratio of the distances, were subsequently confirmed by Taylor and by Whiston in the *Phil. Trans.* for 1721. (Noad, "Manual of Elec.," 1859, p. 579.)

See also Aglave et Boulard, "Lumière Electrique," Paris, 1882, p. 18; Priestley, "Familiar Intr. to Study o Elec.," London, 1786, p. 60; *Phil. Trans.*, abridged, vol. V., pp. 408 and 411; *Chemical News*, vol. II., p. 147; Nicolas Desmarets, "Expériences, etc.," Paris, 1754, in "Recueil des Mémoires de l'Acad. des Sciences."

A. D. 1705.——Keill (John), M. A., F. R. S., Savilian Professor of Astronomy, is the author of "Introductio ad Veram Physicam, etc.," of which other additions appear in 1725, 1739 and 1741, and a good English translation of which was published at Glasgow in 1776.

The last named is entitled "An Introduction to Natural Philosophy, or Lectures in Physics read in the University of Oxford in the Year 1700." In Lecture VIII. he states: "It is certain that the magnetic attractions and directions arise from the structure of parts; for if a loadstone be struck hard enough, so that the position of its internal parts be changed, the loadstone will also be changed. And if a loadstone be put into the fire, insomuch that the internal structure of the parts be changed or wholly destroyed, then it will lose all its former virtue and will scarce differ from other stones. . . . And what some generally boast of, concerning effluvia, a subtile matter, particles adapted to the pores of the loadstone, etc., does not in the least lead us to a clear and distinct explication of these operations; but notwithstanding all these things, the magnetick virtues must be still reckoned amongst the occult qualities."

A. D. 1706.——Hartsocker (Nicolas), Dutch natural philosopher, friend of Huyghens, while professor of mathematics at Düsseldorf, writes his "Conjectures Physiques," four editions of which were published during the three years 1708, 1710 and 1712.

The Tenth Discourse of the Second Book (pp. 140–182) treats of the nature and properties of the loadstone and gives numerous observations concerning magnetical phenomena, which are well illustrated. He says that many ordinary stones have become magnetic after being long exposed to the air, in consequence of iron penetrating them. He believes that the native loadstone is made up of ordinary stone and of iron containing many small bodies through which run magnetic channels; that the latter are held together so strongly as to be disintegrated with difficulty, and that they are filled with a subtile matter which circulates incessantly through and around them.

The First Discourse of the Fourth Book treats of Meteors, and at pages 91–99 of his "Eclaircissements, etc." (1710 Addition) he gives further reports of his curious observations on magnetic phenomena.

A. D. 1707.——J. G. S. (not, as many suppose, Jean George Sulzer) publishes "Curious speculations during sleepless nights," 8vo, Chemnitz, wherein appears the first account of the development, by heat, of electricity in the *tourmaline*, which latter, it is therein stated, was first brought from Ceylon by the Dutch in 1703. Another report of the above appears in the *Mémoires de l'Académie des Sciences* of Paris for 1717.

See Beckmann, Bohn, 1846, vol. I., pp. 86–98.

A. D. 1708.——Wall (Dr. William), a prominent English divine, communicates to the Royal Society (*Phil. Trans.*, vol. XXVI., No 314, p. 69) the result of his experiments, showing him to have been the first to establish a resemblance of electricity to thunder and lightning.

He found that, upon holding tightly in the hand a large bar of amber and rubbing it briskly against woolen cloths, "a prodigious number of little cracklings was heard, every one of which produced a little flash of light (spark); and that when the amber was drawn lightly through the cloth it produced a spark but no crackling." He observes that "by holding a finger at a little distance from the amber a crackling is produced, with a great flash of light succeeding it, and, what is very surprising, on its eruption it strikes the finger very sensibly, wheresoever applied, with a push or puff like wind. The crackling is fully as loud as that of charcoal on fire. . . . This light and crackling seem in some degree to represent thunder and lightning."

See Bakewell, "Electric Science," p. 13; Aglave et Boulard, "Lumière Electrique," 1882, p. 17; *Phil. Trans.*, vol. XXVI., p. 69; Thos. Thompson, "Outlines of the Sciences, etc.," London, 1830, p. 463.

A. D. 1712.——The great Japanese Encyclopædia, *Wa-Kan-san siŭ-tson-ye*, describes the compass, *zi-siak-no-fari*, at vol. XV., folio 3, *recto* (Klaproth, "Lettre à Mr. De Humboldt, etc.," 1834, p. 107).

A. D. 1717.——Leméry (Louis), two years after the death of his distinguished father, Nicolas Leméry, exhibits a stone (the *tourmaline*) brought from Ceylon, and announces, to the French Académie des Sciences, that it possesses the electrical property of attracting and repelling light bodies after being warmed.

Linnæus alludes to the experiments of Leméry, in his *Flora Zeylonica*, and mentions the stone under the name of *lapis electricus*.

The first scientific examination of the electric properties of the tourmaline was, however, made by Æpinus in 1756, and published in the Memoirs of the Berlin Academy. Æpinus showed that a temperature of between 99½° and 212° F. was necessary for the development of its attractive powers.

Of the electricity of crystals, Gmelin, in his "Chemistry" (vol. I., p. 319), names the following discoverers: Æpinus (tourmaline)—see A. D. 1759; Canton (topaz)—see A. D. 1753; Brard (axinite)—see A. D. 1787; Haüy (boracite, prehnite, sphene, etc.)—see A. D. 1787; Sir David Brewster (diamond, garnet, amethyst, etc.)—see A. D. 1820; and

* Continued from THE ELECTRICAL WORLD, June 27, 1891.

Hankel (borate of magnesia, tartrate of potash, etc.). See Becquerel, "Résumé," 1858, p. 11: Leithead, "Electricity," p. 239.

A. D. 1720.——Grey, or Gray (Stephen), a pensioner of the Charter House and Fellow of the Royal Society, makes known through his first paper in the *Phil. Trans.* the details of the important line of investigation which finally led to the discovery of the principle of electric conduction and its insulation as well as to the fact, not the principle, of induction (See Æpinus, A. D. 1759). *Thus, to Grey is due the credit of having laid the foundation of electricity as a science.*

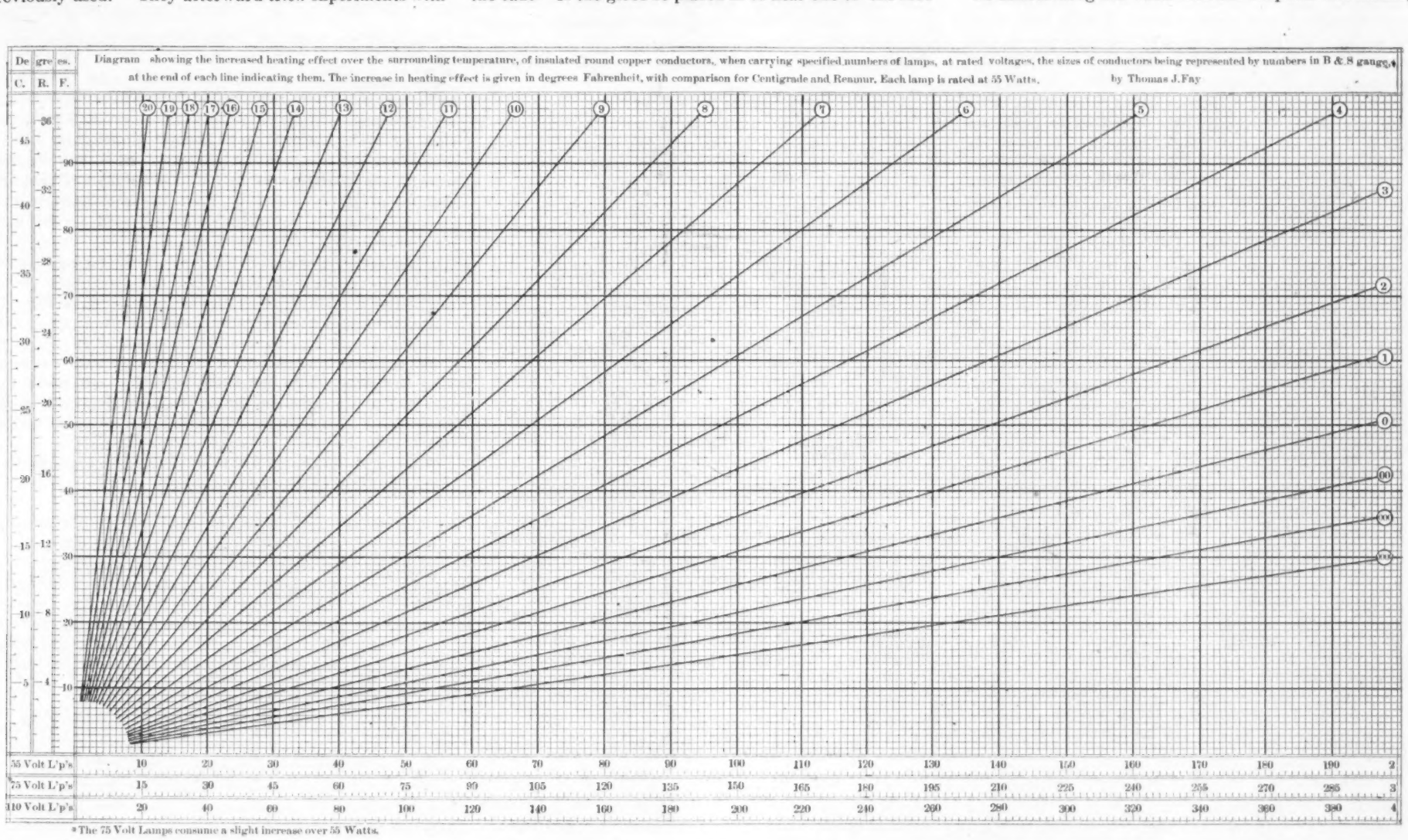
He shows that electricity can be excited by the friction of feathers, hair, silk, paper, linen, etc., all of which attract light bodies even at a distance of eight or ten inches. He next discovers that electricity can be communicated from excited bodies to bodies incapable of excitation. When first suspending a hempen line with pack threads he could not transmit electricity, but when suspending the line with silken threads he transmitted the electrical influence at distances of several hundred feet. The latter he did at the suggestion of his friend Granville Wheeler—Wheler—(not Checler, as Aglave et Boulard have it in "Lumière Electrique," p. 20), thinking that "silk might do better than pack thread on account of its smallness, as less of the virtue would probably pass off by it than by the thickness of the hempen line which had been previously used." They afterward tried experiments with longer lines of pack thread, but failed, as they likewise did after substituting thin brass wire for the thread. This showed them the insulating property of silk and led to the discovery of other insulating substances, like hair, resin, etc. During the months of June, 1729, and August, 1730, Grey and Wheeler succeeded in transmitting electricity through pack thread supported by silken cords a distance of 765 feet, and through wire at a distance of 800—886 feet.

Grey demonstrated also that electric attraction is not proportioned to the quantity of matter in bodies, but to the extent of their surface. He likewise discovered the conducting powers of fluids and of the human body. Of the cracklings and flashes of light he remarks: "And although these effects are at present but *in minimis*, it is probable, in time, there may be found out a way to collect a greater quantity of the electric fire, and consequently to increase the force of that power, which by several of those experiments, if we are permitted to compare great things with small, seems to be of the same nature with that of thunder and lightning." (*Phil. Trans.*, abridged, vol. VIII., p. 401.)

Stephen Grey may be said to have continued his experiments while lying upon his deathbed, for, unable to write, he dictated to the last, as best he could, the progress he had made in his studies to Dr. Mortimer, the Secretary of the Royal Society. (*Phil. Trans.*, 1735-1736, vol. XXXIX., p. 400.)

Grey's own description of a new electric planetarium deserves reproduction here: "I have lately made several new experiments upon the projectile and pendulous motions of small bodies by electricity; by which small bodies may be made to move about larger ones, either in circles or ellipses, and those either concentric or excentric to the centre of the large body about which they move, so as to make many revolutions about them. And this motion will constantly be the same way that the planets move around the sun, viz., from the right hand to the left, or from west to east. But these little planets, if I may so call them, move much faster in their apogeon than in the perigeon part of their orbits, which is directly contrary to the motion of the planets around the sun." To this should be added the following description of the manner in which these experiments can be made: "Place a small iron globe, of an inch or an inch and a half in diameter, on the middle of a circular cake of rosin, seven or eight inches in diameter, greatly excited; and then a light body, suspended by a very fine thread, five or six inches long, held in the hand over the centre of the cake, will, of itself, begin to move in a circle around the iron globe, and constantly from west to east. If the globe is placed at any distance from the centre of the circular cake, it will describe an ellipse, which will have the same excentricity as the distance of the globe from the centre of the cake. If the cake of rosin be of an elliptical form, and the iron globe be placed in the centre of it, the light body will describe an elliptical orbit of the same excentricity with the form of the cake. If the globe be placed in or near one of the foci of the elliptical cake, the light body will move much swifter in the apogee than in the perigee of its orbit. If the iron globe is fixed on a pedestal an inch from the table, and a glass hoop, or a portion of a hollow glass cylinder, excited, be placed around it, the light body will move as in the circumstance above mentioned, and with the same varieties."

See also Priestley, "Hist. and Present State of Elec.," 1775, pp. 26-42, 55-63; and "A New Universal History of Arts and Sciences," *Electricity*, vol. I., p. 460; *Saturday Review*, August 21, 1858, p. 190; Wilson, "Treatise," 1752, Section 4, Prop. I., p. 23, note; *Phil. Trans.*, abridged, vol. VII., pp. 18-20, 23; "Hist. de l'Académie des Sciences," 1733, p. 31; "Jour. Litter." de 1732, à la Haye, pp. 183, 186, 187, 197; "Hist. Académie Royale de Berlin," 1746, p. 11.


Degrees C. R. F.
Diagram showing the increased heating effect over the surrounding temperature, of insulated round copper conductors, when carrying specified numbers of lamps, at rated voltages, the sizes of conductors being represented by numbers in B & S gauge, at the end of each line indicating them. The increase in heating effect is given in degrees Fahrenheit, with comparison for Centigrade and Reaumur. Each lamp is rated at 55 Watts. by Thomas J. Fay
55 Volt L'p's
75 Volt L'p's
110 Volt L'p's
* The 75 Volt Lamps consume a slight increase over 55 Watts.

FAY'S WIRING DIAGRAM FOR THE HEATING OF INSULATED COPPER WIRES.

## Diagram for the Application of the Law of Heating as it Affects Insulated Electrical Conductors.

BY THOS. J. FAY.

In the presentation of the accompanying diagram to the electrical reader, a few remarks upon some of the most important points embraced will be appropriate. The object of the diagram is to obviate calculations as much as possible, when it is found necessary to determine the carrying capacity in ampères of an electrical conductor. A number of diagrams have been placed before the public for this purpose, but, so far as the writer is aware, all of them have been based on a given increase of temperature, while this diagram, it will be seen, can be used for the heating effect due to any increase in temperature over that of the surrounding atmosphere.

It will also be seen that this diagram contains a comparison of Fahrenheit, Centigrade and Réaumur degrees, which it is thought will not be out of place. However, as this scale is constructed to read "above the surrounding temperature," the proportion from F. degrees to C. degrees is as 212 : 100, and not as 212 — 32 : 100, which would be the case in calculating for difference in degrees under usua conditions. This rule also holds good in calculating for the difference between F. degrees and R. degrees under these circumstances.

In the scale for lamps, three voltages are employed, *i. e.*, 55, 75 and 110. Assuming that each lamp consumes 55 watts, the column of 55-volt lamps may also be read as ampères, because a 55-volt lamp to consume 55 watts must carry one ampère. The 75-volt lamps are rated at a slight increase in consumption over 55 watts.

The lines representing the ratio between ampères or lamps and heating effect also represent the required size of the conductor in B. & S. gauge, there being one line for each size from No. 0000 to No. 20. It is not considered advisable, however, to employ a wire smaller than No. 16 for lighting purposes, owing to the low tensile strength of the smaller wires.

In determining the ratio between ampères and heating effect, many practical as well as theoretical considerations were taken into account. In most diagrams, or tables for that matter, the ratios are based upon results obtained by using a bare, bright, round conductor, exposed to the atmosphere; as a matter of fact, no such conditions are ever met in actual practice, while on the other hand we will often employ conductors covered with insulation which is also a non-conductor of heat (for that matter all insulators are to a very great extent), and then inclosed in an additional covering, such as molding. Under these and most ordinary conditions tables based upon results obtained by using bare wire will prove erroneous to a very alarming extent.

An advantage is also gained by employing this diagram for the reason that one is not confined to a single temperature, which is usually the case, and in wiring in installations where different rooms are heated to different temperatures (such, for instance, as an engine room and a refrigerator) due allowance may easily be made for such differences.

It will be well to remember that this diagram is only intended for use in proportioning conductors for cross section, as the resistance of a conductor, due to its length, follows a different law, and must be separately dealt with.

If used strictly for the specified purpose for which it is intended this diagram will be found very useful in wire calculations in a large number of installations now either computed from formulas not applicable to the case or merely roughly estimated.

## Electrical Cable Testing.—II.

BY HENRY W. FISHER.

FOURTH—LOCATING LEAKS, GROUNDS, CROSSES AND OPEN WIRES.

In the electrical profession there is a great tendency to cut and test a cable for faults instead of first accurately locating the faults and afterward removing them with little trouble and expense. Of course, one great drawback to proceeding systematically in this way is the necessarily very heavy expense of purchasing electrical instruments, such as can be relied upon for accurate results.

Then, again, it is generally supposed that this work cannot be done successfully except by electrical experts of long practice and considerable experience. It is the object of the writer to present several methods to fit practical cases, and in doing this he hopes to be able to treat the subject comprehensively enough to meet the ordinary demands of practice, and yet simply enough to enable any person familiar with the use of electrical instruments to meet with success in locating faults.

GROUNDS AND LEAKS.

For this work a Thomson reflecting galvanometer, a Wheatstone's bridge and a battery are needed.

In localities where there is no conduit system, cables are often laid in wooden boxes, or in iron or cement pipes, which are buried three or four feet below the surface of the ground. Not infrequently the street is afterward paved with asphalt or stone, and hence, if such cables become faulty it is a matter of considerable consequence that the faults be located very accurately. Cables laid in this manner are sometimes injured by workmen while digging to lay gas or water pipes, and moisture entering the cable gradually grounds the conductors. Whether the workmen break into the cable accidentally or out of curiosity is usually a matter of conjecture; at all events the damage done is seldom reported, and the company owning the cable is often subjected to considerable inconvenience and loss thereby.

Sometimes there is an unequal distribution of resistance in a cable, owing to poor contact in some of the wire joints. It would be accidental if a fault in such a cable were located accurately, for the tests are based upon the assumption that the resistance is equally distributed. If the cable runs close to steam pipes for a considrable distance in a district that is heated by steam, corrections covering the rise of resistance due to the heated part of the cable must be made. It occasionally happens that a cable with conductors of one size is spliced to a cable with conductors of another size. In such a case, corrections based upon the ratio of the area of the two conductors, or upon the ratio of their relative resistance, must be made. A method of making such corrections will be given later on.

In locating grounds and leaks the conditions for greatest accuracy demand that there shall be two good wires accessible in addition to the faulty wire. It is not necessary that these wires run by the same route that the grounded wire does. All that is required is that their terminals be within easy reach of the ends of the faulty wire.

After having set up the instruments in a convenient room close to one end of the cable, run two wires of equal dimensions from the Wheatstone bridge to the cable. The galvanometer should be placed as far as possible from the street, so that the needle will not be affected by passing wagons.

The first step will be to measure very carefully the resistance of the two wires that run to the cable. Then connect the two good wires and the faulty wire at the distant end of the cable, and measure in turn the combined resistance of the faulty wire and one of the good wires; the faulty wire and the other good wire; and the two good wires. The object of making these three measurements is to enable us to calculate the exact resistance of the faulty wire. Then letting

$l$ = ½ the resistance of the lead wires,
$K$ = the combined resistance of the lead wires, the grounded wire, and one good wire,
$K'$ = the combined resistance of the lead wires, the grounded wire, and the other good wire,
$K''$ = the combined resistance of the lead wires and the two good wires,

the actual resistance of the grounded wire =

$$\frac{K + K' - K'' - 2\,l}{2}. \qquad (1)$$

We will call this $d$ for convenience in further reference. This gives the exact resistance of the grounded wire, provided it be not grounded in more than one place.

Now make the connections shown in Fig. 3. $A$ and $B$ are the arms of the bridge, $R$ is the resistance in the box, $l$ $l$ the lead wires running to the cable, $c$ is the good wire, $a$ and $b$ separate portions of the faulty wire grounded at $g$, $G$ is the galvanometer. Ground one side of the battery (preferably to the lead cover of the cable) and connect the other to the juncture of $B$ and $A$, as shown in the diagram; remove plugs from the resistance box until on pressing down the battery and galvanometer keys no deflection of the galvanometer needle is observable. Then letting the letters in Fig. 3 stand for the resistances of the various parts, we have

$$a = \frac{B\,(d + c + l) - A\,(l + R)}{A + B}. \qquad (2)$$

To obtain the value of the term $(d + c + l)$ simply subtract one-half the resistance of the lead wires from the total resistance of the loop as measured.

Letting $D$ represent the total length of the grounded wire, we have as the distance to the ground, $\frac{a}{d} D$.

The following check method should always be used: Reverse the lead wires at the binding posts of the bridge, as shown in Fig. 4; remove the plugs until a balance is obtained.

$$\text{Then } a = \frac{A\,(d + c + l + R_1) = Bl}{A + B}. \qquad (3)$$

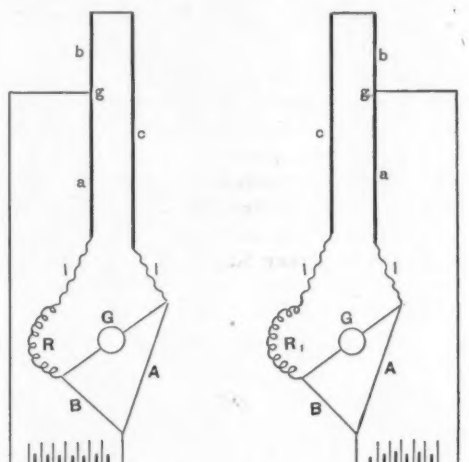
The values of $a$ as calculated by these two methods should agree very closely. $R$ will always be greater than $R_1$; hence by remembering this it will not be necessary to identify the lead wires at the Wheatstone bridge. Never rely upon an approximate estimation of the length of a cable; accuracy demands that the exact length be known. It is therefore better to measure the route of the cable with a tape line than to rely upon city charts or maps. Four cells of battery will be sufficient for ordinary use, but where a leak of several thousand ohms is to be located 50 or even 100 cells ought to be used in the last two methods. For ordinary testing $A = 10$, $B = 1000$.

The following two examples are given to illustrate the practical application of these formulæ. They are two of many actual tests that were made by the writer, and they can be considered as representing an average degree of accuracy.

ILLUSTRATIVE EXAMPLE NO. 1.

The test was made on a telegraph cable 10,530 feet long, in which several wires had quite suddenly become grounded.

The faulty wire was numbered 23 and the good wires




Figs. 3 and 4.—Connections for Cable Testing.

were numbered 7 and 9 respectively. The values of the measurements as made are as follows:

Resistance of leads = .251 ohm;

$$\therefore l = \frac{1}{2} \times .251 = .126 \text{ ohm.}$$

Resistance of 9 and 23 and leads = $K$ = 57.402 ohms.
Resistance of 7 and 23 and leads = $K'$ = 57.447 ohms.
Resistance of 7 and 9 and leads = $K''$ = 57.435 ohms.

Refering to formula (1) we have for the resistance of the grounded wire,

$$d = \frac{57.402 + 57.447 - 57.435 - .251}{2}$$

$$= 28.5815 \text{ ohms.}$$

Using the methods for finding the resistance of the conductor to the ground the following data were obtained:

$R$ = 3745.1 ohms; $A$ = 10;
$R_1$ = 1941.2 ohms; $B$ = 1000;

and the resistance of the conductor to the ground is by the first method, formula (2):

$$a = \frac{1000\,(57.196 + .126) - 10\,(3745.1 + .126)}{1000 + 10}$$

$$= 19.672 \text{ ohms;}$$

$$\text{and the distance to the ground} = \frac{19.672}{28.5815} \times 10530 \text{ feet}$$

$$= 7248 \text{ feet.}$$

By the second method, formula (3), we have

$$a = \frac{10\,(57.196 + .126 + 1941.2) - 1000 \times .126}{1{,}000 + 10}$$

$$= 19.663 \text{ ohms;}$$

$$\text{and the distance to the ground} = \frac{19.663}{28.5815} \times 10530 \text{ feet}$$

$$= 7244 \text{ feet.}$$

These measurements brought the fault to a small alley, and on digging down to the cable it was found that a water pipe had been laid below the cable conduit, and that the cable had been injured by the pick of a workman.

ILLUSTRATIVE EXAMPLE NO. 2.

The point of difference between this example and the one just given is that in the first case the wire was badly grounded, while here the resistance of the leak measured over 1,500 ohms. The methods used are identical.

The test was made on 4,820 feet of telephone cable. The faulty wire was numbered 1 and the good wires were numbered 5 and 6. The values of the measurements are made as follows:

Resistance of leads = .075 ohm.

$$\therefore l = \frac{.075}{2} = .0375 \text{ ohm;}$$

Resistance of 1 and 5 and leads = $K$ = 64.42 ohms.
Resistance of 1 and 6 and leads = $K'$ = 64.27 ohms.
Resistance of 5 and 6 and leads = $K''$ = 65.47 ohms.

Referring to formula (1) we have for the resistance of the grounded wire:

$$d = \frac{64.42 + 64.27 - 65.47 - .075}{2}$$

$$= 31.57 \text{ ohms.}$$

Using the methods for finding the resistance to the ground the following data were obtained:

$R$ = 3984 ohms; $A$ = 10;
$R_1$ = 2376 ohms; $B$ = 1000;

and the resistance of the conductor to the ground is, by the first method, formula (2):

$$a = \frac{1000\,(64.19 + .04) - 10\,(3984 + .04}{1000 + 10}$$

$$= 24.14 \text{ ohms;}$$

$$\text{and the distance to the ground} = \frac{24.14}{31.57} \times 4820 \text{ feet}$$

$$= 3686 \text{ feet.}$$

By the second method, formula (3), we have

$$a = \frac{10\,(64.19 + .04 + 2376) + 1000 \times .037}{10 + 1000}$$

$$= 24.12 \text{ ohms;}$$

$$\text{and the distance to the ground} = \frac{24.12}{31.57} \times 4820 \text{ feet}$$

$$= 3683 \text{ feet.}$$

The fault was found at about 3,679 feet from the end of the cable.

It is often the case that only one good wire in addition to the grounded wire is accessible; and where this is so, if the good wire is in the same cable as the grounded wire,—that is, if it has the same general dimensions as the grounded wire,—the approximate resistance of the grounded wire may be found by taking half the actual combined resistance of the two wires. Then the resistance to the ground is found by proceeding as is indicated in the two previous methods, after which the distance to the ground is calculated by mutiplying the total length of the grounded wire by the resistance to the ground, and dividing the product by half the actual resistance of the two conductors.

This method is illustrated by a test made to locate a fault on a No. 0 B. & S. gauge electric light cable.

The conditions under which this test was made were not very favorable, and a moment's reflection will reveal the fact that it is much more difficult to locate a fault accurately in an electric light cable than in a telephone cable, on account of the low resistance of the former.

The test was made on 5,045 feet of electric light cable.

Resistance of leads = .0706 ohm.

$$\therefore l = \frac{.0706}{2} = .0353 \text{ ohm.}$$

Resistance of good wire, grounded wire and leads, = 1.1200 ohms.

Approximate resistance of grounded wire, $= \frac{1.1200 - .0706}{2}$

$= .5247$ ohm.

First method, $R$ = 62.67 ohms; $A = 10$; $B = 1000$.
Second method, $R_1$ = 48.73 ohms.

Referring to formula (2) we have for the resistance to the ground

$$a = \frac{1000\,(1.0494 + .0353) - 10\,(.0353 + 62.67)}{10 + 1000}$$

$$= .4544 \text{ ohm;}$$

$$\text{and the distance to the ground} = \frac{.4544}{.5247} \times 5045 \text{ feet}$$

$$= 4369 \text{ feet.}$$

Referring to formula (3) we have for the resistance to the ground

$$a = \frac{10\,(1.0494 + .0353 + 48.73) - 1000 \times .0353}{10 + 1000}$$

$$= .4583 \text{ ohm;}$$

$$\text{and the distance to the ground} = \frac{.4583}{.5247} \times 5045 \text{ feet}$$

$$= 4407 \text{ feet.}$$

The fault was found near the point indicated by the first method.

Sometimes, but rarely, it becomes necessary to locate a ground when no good wire is accessible. Could we be assured that the resistance of the ground was invariable, this would not be a very difficult undertaking. But in practice grounds are usually caused by moisture, and hence, unless special devices are used, the resistance of the ground will change, through polarization, while the test is being made. The following method is based upon the assumption that the resistance of the ground is unvariable, and to come as nearly as possible to this condition it will be necessary to use a secohmmeter. This instrument alternates the current going through the ground and thus prevents polarization, while at the same time it commutates the galvanometer current so as to deflect the needle steadily.

The plan of procedure is as follows: Set up the instruments at one end of the cable, and run two lead wires from the Wheatstone bridge; connect one of these to the faulty wire and ground the other thoroughly to the lead of a cable or to a gas or water pipe; measure the resistance of the circuit; then proceed to the other end of the faulty wire and do likewise, using the same lead wires or ones having an equal resistance.

Then letting $a$ = the resistance to the ground from one end of the cable,
letting $R$ = the total resistance as measured from the same end,
letting $R_1$ = the total resistance as measured from the other end of the cable,
letting $R_{11}$ = the resistance of the faulty wire,

$$a = \frac{R + R_{11} - R_1}{2}. \qquad (4)$$

To find $R_{11}$ multiply the resistance per foot of the wire in question by the length of the grounded wire expressed in feet. The resistance per foot is found from a table of comparative resistances for different sizes of wires.

Finally the distance to the ground is equal to

$$\frac{a}{R_{11}} D,$$

where $D$ is the length of the grounded wire.

If the resistance of the ground is variable it will in general be indicated by the difficulty to obtain a balance with the Wheatstone bridge.

These methods are only applicable to a conductor that is grounded at one point. When there are two or more grounds on one conductor complications occur that often defy solution.

In making measurements to locate a ground it is absolutely necessary to make connections to the same faulty wire at both ends of the cable. Where there are several

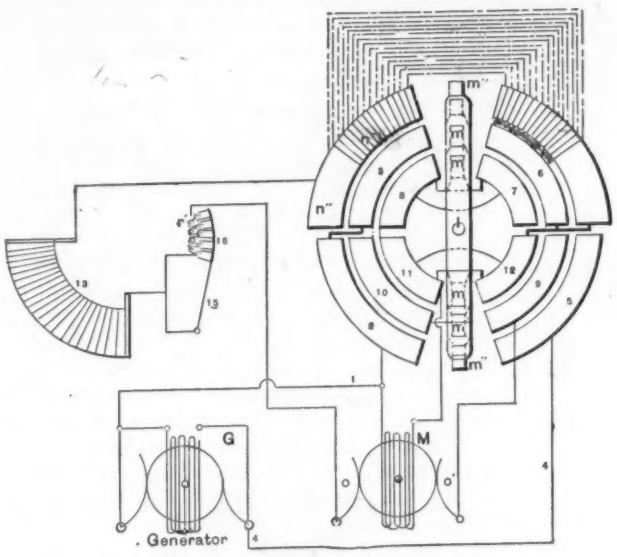



FIG. 7.—OTIS ELECTRIC ELEVATOR.

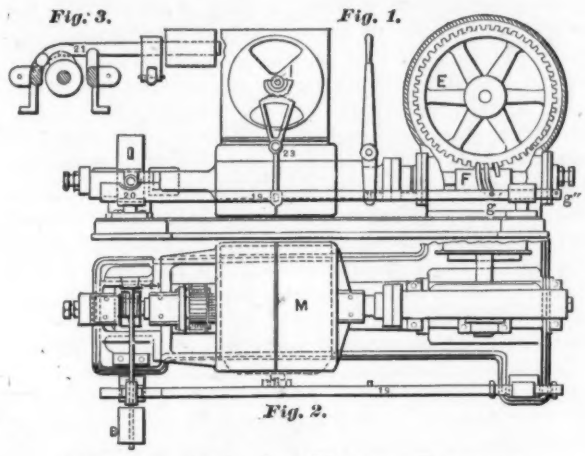
badly grounded wires in one cable it is not easy by ordinary methods to identify the separate faulty wires at both ends of the cable. If all the wires have been tagged before the ground appeared this difficulty has not to be contended with. When this is not the case identification is generally rendered certain by the following method: Connect one wire from the Wheatstone bridge to a good wire and the other to a grounded wire; connect the same good wire to one of the grounded wires at the other end of the cable; measure the resistance of the loop, and as soon as a balance has been obtained reverse the battery and see if a balance is still obtained; if not, connect another grounded wire to the Wheatstone bridge, leaving the connections at the distant end unchanged; measure the resistance of the new loop, and test it in a manner similar to the above; keep on changing and testing till reversing the battery does not affect the balance of the Wheatstone's bridge. Then the ends under test, being the terminals of one continuous wire, can be tagged with the same mark or number

## The Otis Electric Elevator.

Among the machinery shown at the Frankfort Electric Exhibition is an electric elevator contributed by the American Elevator Company, of Mansion-House Building, Queen Victoria street, London. It is constructed on the plan followed by Messrs. Otis Brothers, of New York, who have a considerable number of these at work, the current being obtained from the same mains as that for electric lighting. For the following description of the machines as shown in the exhibit, together with the accompanying cuts, we are indebted to *Engineering*. Our readers will remember that an illustrated description of this elevator fitted with an Eickemeyer motor was given in THE ELECTRICAL WORLD, July 5, 1890.

Special care has been taken to prevent the armature being subject to such a current as would heat it too much and endanger the insulation. It has hitherto been a difficulty in this class of machine that the armature was apt to be burned out by a sudden rush of current due to the slowing of the motor from any cause. To prevent this, various means have been devised of automatically putting resistances in or out of circuit, as, for instance, by means of a centrifugal governor, as was done by Messrs. Siemens Brothers in 1882. It will be seen that very complete and, we understand, very successful means are employed by Messrs. Otis Brothers, of New York (the American Elevator Company, London), to guard against this class of mishap, and o make their electric elevators as successful as their hydraulic ones.

Figs. 1 and 2 show one form of the elevator. $E$ is a drum on which the wire ropes carrying the cage are wound. The drum is rotated by a worm wheel and a worm $F$, the latter being on the armature spindle of an electric motor $M$. By rotating the motor in one direction or the other, the cage can be raised or lowered. In the arrangement shown the manipulation of the switches and brake is effected by a hand lever, but it is of course more customary to do it with a rope passing through the cage as in Fig. 8. The hand lever slides the bar 19 backward and forward within the limits defined by the stops $g^1$ and $g^{11}$. At one part of the bar is a depression 20, and when a roller at the end




FIGS. 1, 2 AND 3.—OTIS ELECTRIC ELEVATOR.

of the brake lever drops into this (Fig. 3) a brake block is pressed against a brake pulley on the armature spindle and stops the entire mechanism. Connected also to the bar 19 is a toothed quadrant 23 gearing into a pinion on a switch. When this switch is operated to start the motor, which is shunt wound, it first directs the current into the field magnets to excite them, and then it puts the armature into circuit, first with a very large additional resistance. This resistance is gradually decreased as the bar is moved over, but even when the bar is at the extreme end of its travel all the resistance is not cut out, for were the cage to stick

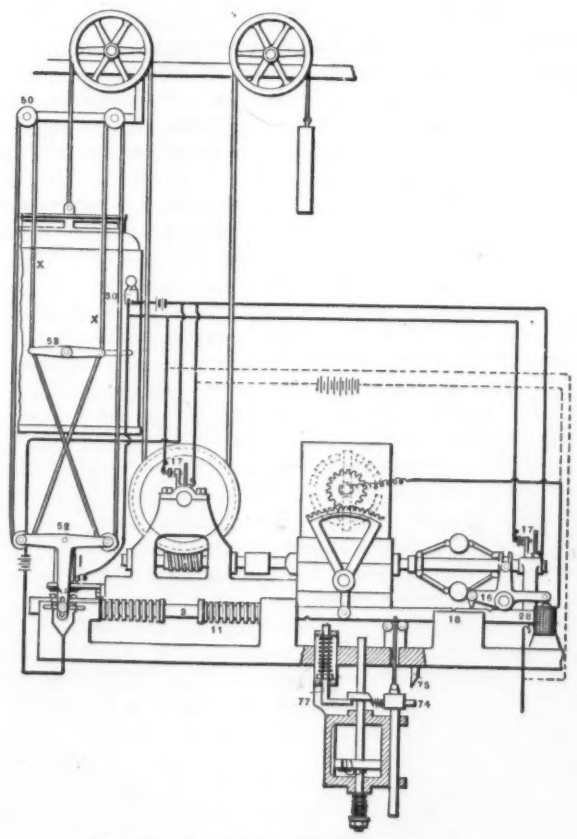
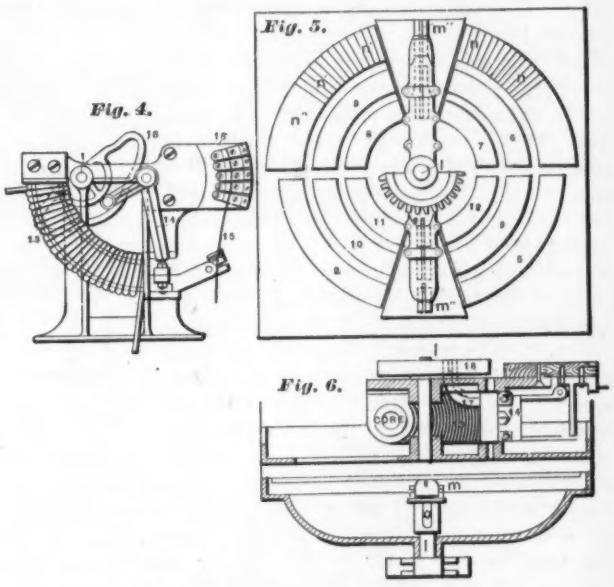


FIG. 8.—OTIS ELECTRIC ELEVATOR.

the current would burn out the armature. The total external resistance is not removed until the cage is moving at full speed, when the back electromotive force generated by the armature guards it from receiving an excess of current. To stop the motor the operations take place in the reverse order.

Fig. 7 is a diagram showing how this is accomplished. The electric generator $G$ is connected on the one hand by the line 1 with the curved plates 2 and 3 on the switchboard, and on the other by the line 4 with the plates 5, 6, 7, and 8; one terminal of the field circuit of the motor $M$ is connected to the plates 2 and 3, and the other to the plates 11 and 12. In the centre of the switch is a spindle $l$ (Figs. 1, 5, 6 and 7), upon which are mounted three brushes, which are insulated from each other. The shorter of the brushes $m$ is of such dimensions that it will connect electrically the plates 8 and 12 of the inner ring when the spindle is turned in one direction, and the plates 7 and 11 when turned in the opposite direction. In either case the current from the generator flows through the field circuit of the motor in the same direction and excites the field. The resistances for insertion in the armature circuit are connected to terminals $n\,n$ (Fig. 5). Over these terminals there moves a brush, and when it comes in contact with the first a circuit is made through the armature of the motor $M$ (Fig. 7). The current will pass from the line 1 to the plate 2, through the brush to the first block at $n$, thence through the resistance coils over the plate $n^{11}$, through the coil 13 (Fig. 4) of the automatic regulator, through the resistance coils of that regulator to one brush of the motor (Fig. 7). The current then flows through the armature to the other brush, and thence through plates 9 and 10, and another of the three brushes to the plate 6, which is electrically connected to the plate 5, and thence to the generator. As the motion of the brushes is continued, one resistance coil after another is cut out of circuit, until none are left except those shown at 16, in Fig. 4 and in the corresponding position in Fig. 7. These latter resistances are not affected by the motion of the bar 19 (Fig. 1), and are only cut out when the armature gets into motion.

The automatic resistance (Fig. 4) consists of a suction coil 13, into which a curved iron core is loosely fitted. One end of this core is attached to an arm of a bell-crank lever 14, which also carries a brush 15, sweeping over the switch blocks 15. The other arm of the bell crank is fitted with a roller working in a groove in a cam 18. This cam is fixed on a shaft $l$ (Figs. 1, 4, 5, 6 and 7). When this shaft is moved by the bar 19 (Fig. 1) and the toothed sector, the cam 18 also moves, but it is so shaped that it holds the bell crank 14 until the brushes on the switchboard have completely cut out the resistance (Fig. 5). At this moment




FIGS. 4, 5 AND 6.—OTIS ELECTRIC ELEVATOR.

the widened part of the cam path comes opposite the roller, and leaves it free to move under the preponderating weight of the curved iron core. As soon as it moves the brush 15 travels over the resistance terminals 16 and cuts them out of circuit. But this cannot take place as long as an excessive current is circulating in the coils 13, for the attraction of the solenoid will then suck in the core and hold it against the influence of gravity. Thus there is no chance of the armature being burned should it fail to get into rotation, for in that case the resistances 16 would be kept in circuit with it.

Other safety appliances in addition to those already described are sometimes used with this elevator, as shown in Fig. 8. Here the shifter bar 3 has upon it two springs 11 which tend to bring it back to the mid-position in case it should not be moved the full extent of its travel and there locked. To lock it there is provided a detent 16 that enters a V-shaped notch 18 in the shifter when it is at either limit of its traverse. This detent is controlled by a governor on a continuation of the armature spindle, and it is only when the spindle is running at the proper speed that the detent holds the bar. If the speed is reduced so as to admit too much current through the armature the detent rises out of the notch and the bar slips back, putting in the resistances. The detent does not hold the shifter bar so firmly as to prevent the man in the cage from manipulating it as he likes. A further security is obtained by the use of the solenoid 28; when the current traversing this rises beyond the normal it lifts the detent 16 and releases the shifter bar.

To guard against the current being left running through the motor continuously, a timing apparatus is used, consisting of a cataract cylinder operating a detent 77. By means of a strap connected to the shifter bar the piston of the cataract is lifted whenever the cage is started. At the top of its stroke the piston is released by the tripping device 74, 75, and commences to descend. When it reaches the bottom of its stroke, its weight comes on to detent 77, withdrawing it from its notch, and releasing the shifter bar.

A thermostat 17 is employed to indicate if the bearings should heat. It is included in an electric circuit, in which is an alarm bell 30 within hearing of the attendant in the cage. A circuit breaker $I$ also sounds the bell when the shifter bar is in any other position than in the middle or the extreme ends of its travel. The man is thus advised whether he has put the lever 53 in the cage completely over or not.

## Electric Organs.*

BY JAMES SWINBURNE.

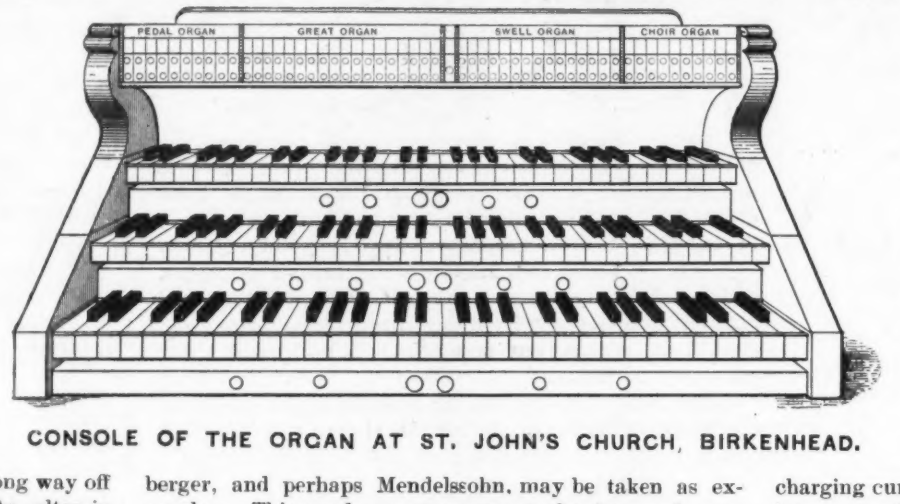
The idea, and to some extent the application, of electricity to the mechanism of organs is not new. Gauntlet proposed to build models of various celebrated organs at the London Exhibition of 1851, and to connect them all to one console. Barker, the inventor of the pneumatic pallet, worked out what was probably the earliest practical system of electrically controlled organs.

An organ consists essentially of three or four independent instruments. Each instrument is composed of sets of pipes called stops, arranged in rows, say crosswise, on what is known as the "soundboard," probably because it is not a soundboard. The pipes are also arranged in rows from back to front, each row corresponding to a key on the keyboard belonging to that organ. Each key commands a valve, or pallet, letting wind into a channel under all the front to back row belonging to it. Each stop has a long perforated slip or slider running under it, which can be moved so that the holes correspond or not with those leading to the pipes. These sliders are controlled by the draw stops. A fourfold organ has one pedal and three manual keyboards, called "great," "swell" and "choir." Further mechanism is necessary to connect various keyboards and to admit of rapid changes of the arrangement of the draw stops. This appears very simple, but when an organ has about 40 stops and over 50 draw stops it becomes very complicated. The first trouble is that it soon becomes almost impossible for the fingers of the left hand to work air valves or pallets large enough to control the wind for 20 or 30 large pipes, even if equilibrium valves are used. I am, as far as possible, using engineering and not organ-building nomenclature. To get over this, the air relay or pneumatic pallet has been adopted in large organs. The finger then controls a tiny equilibrium valve, which controls an air bellows that does all the work. When this system is applied to the "great organ" of a small instrument it is generally arranged to work the "choir" and "swell" too when coupled to the "great." There is still another difficulty. In large instruments the pneumatic pallets frequently have to be a long way off from the player, and the connections are apt to alter in length and get out of adjustment. In All Saints' Church, Manchester, there is, or was, an organ played from near the reading desk, placed high up on each side of the chancel, 70 feet off. It has mechanical connections, but they are not heavy and seem to work very well. Generally an arrangement like that used in pneumatic bells is used, and known as the tubular pneumatic system. Barker, however, controlled his little air-relay valves electrically, and realized the advantages of electrical connections in admitting of great simplicity in coupling and key mechanism, as well as ease in connecting distant organs. The electric action, as it is called, has developed especially abroad. Messrs. Bryceson have done a great deal, and many English organs have electric connections. In France there are a large number of these combined electric and air-relay mechanisms. M. Carre describes several in a valuable article in *La Lumière Electrique*. Roosevelt, in America, has not only developed pneumatic actions thoroughly, but has employed electricity too. The three-manual organ at Trinity Church, Boston, has not only pneumatic action for the keys, but a pneumatic stop action which admits of an exceedingly convenient composition pedal arrangement. The pedal being pressed and hitched down draws its corresponding set of stops, and shuts them off again when allowed to rise, without interfering with any arrangement that has already been made. There is also an electric solo organ, but it was out of order when I tried the instrument. There is a concert organ by the same makers in Boston, with a set of composition pedals, each with a complete set of draw stops, which can be arranged before hand, and come into use when the pedal is pressed. I believe the new Riga organ is electrical. Mr. Hope-Jones has recently paid great attention to the subject of electric actions. Being an electrical engineer and an organist, he is well fitted for tackling such a difficult subject. There is given herewith an illustration of the console of the organ of St. John's Church, Birkenhead, where Mr. Hope-Jones is organist. Instead of draw stops at the sides of the player there are rows of little tumblers just under the music. A touch at the top or bottom puts the stop in or out. This organ, if arranged in the ordinary way, would have about 40 draw stops. By the use of electric gear, Mr. Hope-Jones produces an organ which has the same effect as an instrument of 53 with the ease of manipulation of one of 20 draw stops. In addition, it has a whole host of composition buttons, crescendo arrangements, and other accessories.

So far electricity seems to have been used to work an air relay only. The use of electricity may easily be carried very much further than this. The difficulty has been the supply of electrical energy, and batteries have been used. Mr. Hope-Jones, who has had experience in telephone work, has probably reduced the energy needed to a minimum. It seems obvious, however, that to use electricity to work an air relay for working a valve needing a pull of a pound or two through half an inch is absurd; and our electrical readers may well study the question, as given, say, twenty watts available, the whole mechanism of the ordinary organ might be swept away and an infinitely more convenient and much less costly instrument devised. It is easy to get the power. In England the blower, who does the whole of the work when air relays are used, works a thing like a pump handle up and down. In France he works two levers with his feet. Sometimes the blower is a water motor or a gas engine. All that is wanted is rotary motion. Even if rotary motion is provided, by means of hand cranks, water motors, or gas engines, the feeders are generally on the principle of a smith's bellows. We would suggest that such a machine as the Baker positive blower would be very much cheaper and better, giving a uniform supply without beating. The electric power can then be supplied by a very small magneto machine. This need have no commutator; it may supply alternating currents of low enough frequency to be silent. There is then nothing to get out of order, and owing to hysteresis, if closed circuit electromagnets be used, there is practically no sparking at the various contacts. Organ music is limited entirely by the mechanism of the organ and develops with it. In Germany they have only one sort of organ music, of which the works of Merkel, Rheinberger, and perhaps Mendelssohn, may be taken as examples. This needs no accessory mechanism, and even modern German organs have, we believe, little as a rule. The well-known organ at Tyne Dock, by Schultze, has no composition pedals, and, if I remember aright, no couplers. In France the organ intersperses showy scraps during church service, and many of the organs are not designed for solid playing. The large organ at St. Eustache, for instance, has the pedals so arranged that the player cannot reach them without sliding along the seat. They have all sorts of arrangements for meretricious effects—tremulants, fancy reeds, and *effets d'orage*. In England and the United States organ playing has got as far as it can without a change in organ construction. The average church organ spends its time in the monotonous accompaniment of hymns and chants, but the concert instrument plays German fugue music, German chorale organ music or the resulting German organ sonata; then it plays Guilmant and light French music, and then it indulges in a development which is essentially English, the organ arrangement. As much of an orchestral movement as can possibly be compressed into the region of ten fingers and two feet is crammed on three staves, and the organist has to change his stops as best he can. It is probably only in England and America that such things as the overtures to "Der Freischütz" or "A Midsummer Night's Dream" are played on organs. It is only because the mechanism does not give the right combinations quickly enough, if at all, that the overture to "Tannhaüser" does not figure on recital programmes.

It is difficult to think of all that can be done easily and cheaply by direct electric mechanism. If each key makes circuits with a set of small electric valves, one to each pipe, and if the returns to each stop are controlled by what corresponds to the draw stop, all the ordinary mechanism of pneumatic pallets, expensive soundboards—which sometimes warp—trackers, sliders, rollers, etc., may be swept off. It may be remarked parenthetically that the abolition of pneumatic pallets is itself most desirable. Apart from expense, they tend to develop a bad style of playing. The organ cannot accent a note by playing it louder, so emphasis is given to it by clipping the note before it a little short. Phrasing thus depends on perfect instantaneousness of the action, which is not always found with the air relay. In a cathedral, organ music gets mixed up into a sort of roar which rolls down the aisles in a way poets like, and slovenly phrasing does not matter, but in a concert room an organist accustomed to a large instrument generally hears evidence of it. With electric mechanism, any stop may be drawn on any manual, or prearranged for any manual and composition button. Any grouping may thus be adopted. In orchestral music, though there are about twenty staves in the score, the instruments fall roughly into a few groups. It should be easy to group the corresponding stops on the organ in the same way for playing orchestral music. This can be done by electricity. Again, in playing from the ordinary piano, score of oratorios, there are four lines of voice parts, which demand one keyboard, and two lines of condensed accompaniment, which demand one or two keyboards, which must be coupled instantly to the voice keyboard when there are no hands available to play them. Existing organs generally meet these last requirements. Electric action admits of still another development. In a medium-sized hall, one manual may be an ordinary grand piano. A piano could not be combined with an ordinary organ, because the touch is different; but if the console is detached from the organ so as to give breathing room for the piano, the addition of the contacts to the keys will not interfere with the touch of the piano at all. This suggestion will strike many as odd, some may say barbarous, but the harp may almost be considered part of the modern orchestra, and apart from concertos the piano might also be absorbed too, especially if it were more portable, and several could be employed together.

Enough has been said to show the enormous advantages of simple organ mechanism. One great difficulty will probably be in organ builders themselves. They are often too apt to regard electric action as complicated, untrustworthy and expensive. It must be remembered that electric work has advanced enormously within the last few years; and if electricity can sweep away the whole of the rest of the action mechanism from organs it is certainly worth consideration. The excellence of the organ at Birkenhead points to the advisability of organ builders going to electricians to get the electrical part of their actions put right, instead of designing it themselves and then rejecting it as costly or untrustworthy.




CONSOLE OF THE ORGAN AT ST. JOHN'S CHURCH, BIRKENHEAD.

* From *Industries*.

## Problems Connected with the Chemistry of the Secondary Cell.*

BY G. H. ROBERTSON.

In dealing with the subject of the chemistry of cells of the Planté type, one is struck with how little advance has been made since Messrs. Gladstone and Tribe published their work on the subject in 1882. Then the questions under discussion were local action, the cause of the evolution of gas sometimes observed on first breaking the charging current, the high initial E. M. F., the resuscitating power of the cell—all problems which had been raised by Planté in his "Recherches sur l'Electricité"—and the reducibility of lead sulphate. Turning to recent work, we see nearly the same difficulties still presenting themselves for solution, and, in addition, the question of the temperature changes occurring in the cell has been raised.

Messrs. Gladstone and Tribe found that the sulphating of the peroxide plate due to local action was necessary to the action of the cell, as without it the charge would not be retained long enough to be practically available, and they also pointed out that local action increased with increase of temperature. With reference to the escape of gas, which Planté had attributed to the decomposition of water by local action, they point out that the explanation of local action given by them does not account for the escape of any gas, that the escape of gas is slight and soon ceases, but becomes more pronounced on raising the temperature of the liquid. The gas is oxygen, and heating electrolytic peroxide apart from the lead plate produces an evolution of oxygen, and they further state that testing the liquid between the plates they have always found traces of something which might be ozone or hydrogen peroxide.

Now Planté ("Recherches sur l'Electricité," § 66) noticed the formation of ozone, and observes that a lead voltameter was more favorable to its formation than a platinum, and in § 74 he notes the presence of hydrogen dioxide and similar bodies in the acid, and ascribes the high initial E. M. F. to their influence, pointing out that as they are very unstable they are immediately reduced, and unless the discharge takes place at once they will have disappeared. Both Planté (§ 68) and Messrs. Gladstone and Tribe (p. 27) notice the formation of peroxide of lead on the lead plate during discharge, and that a high rate of discharge is favorable to its formation. With reference to its formation, the latter say: "It is more easy to imagine the peroxide results from the oxidation of the sulphate of lead already formed through the agency of electrolytic oxygen. Hence we get running down of the cell before the peroxide on the peroxide plate is exhausted. On the peroxide plate the peroxide of lead being mixed with a great deal of lead sulphate will suffer decomposition only very slowly through the agency of the supporting plate; but on the lead pipe the peroxide is mixed not only with sulphate of lead, but with spongy metallic lead, and will be speedily reduced to sulphate. Hence after rest an apparently run-down cell is found active." In connection with this theory put forward by Messrs. Gladstone and Tribe in 1882, it is interesting to notice the curves exhibited by Mr. Crompton at the Institution of Electrical Engineers in November last, which show clearly that the higher the rate of discharge the earlier the apparent exhaustion of the cell takes place.

In March, 1883, Frankland (*Proc. Roy. Soc.*, XXXV., 67–70) showed that the occlusion of oxygen and hydrogen had little or nothing to do with the action of the cells,

* From *The Electrician*, London,

that the state of charge or discharge could be readily estimated by the use of the hydrometer, and put forward the theory that the acid concerned in the interactions occurring in the cell was Bourgoin's* hexabasic sulphuric acid. In the same year Mr. Preece (*Proc. Roy. Soc.*, XXXV., 250) showed that the E. M. F. remains practically constant for all degrees of temperature up to 100 degrees C., but that the internal resistance diminishes as the temperature increases at a very steady rate, increasing again as the temperature is lowered.

Since these early discussions we have had the paper "On Reversible Lead Batteries," by Mr. Desmond FitzGerald, read at the Institution of Electrical Engineers, March 10, 1887, which dealt chiefly with lithanode cells; Frankland's paper (*Proc. Roy. Soc.*, 1889, 46); and in reply to it Messrs. Gladstone and Hibbert's two papers (*Phil. Mag.*, Aug., 1890; Jan., 1891). Also the two papers, "The Working Efficiency of Secondary Cells," by Prof. W. E. Ayrton, F. R. S., C. G. Lamb, E. W. Smith and W. Woods; and "The Chemical Action of Secondary Cells," by Prof. W. E. Ayrton, F. R. S., C. G. Lamb and E. W. Smith, read before the Institute of Electrical Engineers last year.

Mr. FitzGerald made experiments illustrating the effect lead sulphate has in lowering the E. M. F. of peroxide of lead by mere admixture with it; and in the discussion on the paper Prof. S. P. Thompson dealt with a number of the hypotheses which have been put forward from time to time, as to the chemical reactions occurring in the cell, and working out the E. M. F. of each from the thermal values given by Tscheltzow (*Comptes Rendus*, vol. C, p. 1,458), showed which were untenable. The other work and the discussion it has given rise to is so recent that it need not be further alluded to, except to say that it is in "The Efficiency of Secondary Cells" that the question of the temperature changes occurring in the cell is raised.

On reviewing the work done in this country since the publication of "The Chemistry of Secondary Batteries," we see that it deals principally with the chemistry of the plates or with physical measurements, and although there have been discussions as to the effect of sodium sulphate, there does not appear to have been any attempt made to determine the character of the reactions occurring in the electrolyte itself, though the formation of peroxide bodies in the acid was noticed both by Planté and Messrs. Gladstone and Tribe, and a great deal of work has been done both in this country and abroad on the electrolysis of sulphuric acid solutions.

## Constant Current Transformers.

BY ELIHU THOMSON.

In THE ELECTRICAL WORLD of June 20, 1891, under the title "Lahmeyer Current Transformer," there is described a machine which is in all respects the same as one which I invented a considerable time ago. The peculiarity of my machine (and this peculiarity agrees with the Lahmeyer machine) is that one of the windings on the armature passes over a supplemental portion of the core influenced by a separate magnetic field in such a way as to cause a regulation for drop to take place.

My machine was designed and constructed for use in systems of distribution with continuous currents, and the machine is a continuous current transformer compounded for drop in the machine itself, for drop in the secondary, and for drop in the high potential or main line leading to the machine. The machine also admits of ready compounding for the combined drop.

Such machines will readily enable a large station to be built, furnishing continuous currents, which are transmitted to sub-stations with the compounded transformers, feeding local mains at low potential. The machines are efficient and require very little care in running. They may be compounded by the primary or the secondary current, or both, acting on the accessory field. The machines may also be made to use continuous currents for driving and produce alternating currents in the secondary system, or they may be run by alternating currents and produce continuous currents.

The accompanying illustration shows one of such machines which I have had in use for a considerable time past. It is adapted to charge storage batteries at low potential by one of its windings, taking in current at comparatively high potential on the other winding. It will be seen that the field is divided into a large and small field magnet, the large one being energized in shunt and affecting both windings, while the small field is wound, in the present instance, differentially, and affects only one of the windings, in this case the low potential winding. The similarity of this machine to the Lahmeyer machine is evident.

I have worked out the principle in a variety of ways, and of course it is impossible to say to whom priority belongs in this instance. It is another curious instance of the independent working out of the same invention by different workers in the field.

In this connection I may remark that inventors here in the United States labor under a disadvantage as to publication which is not always present with foreign inventors. Our applications for patents in the United States require that a system of examination be had, which often consumes months and sometimes years, especially if the inventor is strenuous in obtaining claims which are broad enough to cover his invention and is not satisfied with the most limited claims, and especially, also, if the examiner, as is sometimes the case, makes renewed objections on technical grounds. The judgment of the courts has been that should the United States applicant apply for foreign patents before the issue of his United States case, his United States patents will be limited to expire with the date of the shortest foreign patent. He is therefore restrained from publishing any new invention or discovery at the time it is made, simply because if he does so he loses his rights to foreign patents, in accordance with the requirements of foreign countries that prior publication must defeat a patent. On the other hand, if he applies for foreign patents before his United States case issues, he must sacrifice so many years of the term of the United States patent as expresses the difference between the shortest term foreign patent and the 17 years granted in the United States. It is within my knowledge that a considerable number of valuable electrical inventions which have been first published abroad have been made in the United States in the course of our more extended electrical work as a consequence of the conditions mentioned above.

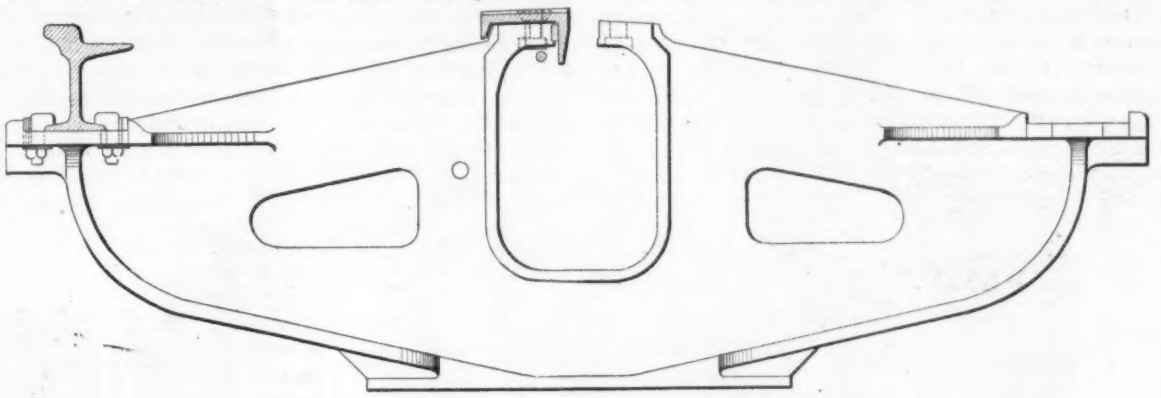
*Bourgoin, *Comptes Rendus*, Vol. LXIX., p. 890.




THOMSON CURRENT TRANSFORMER.

## An Electric Railway Conduit.

The preliminary work on an electrical installation of great interest to all street railway officials will be commenced next week on the Fullerton avenue loop line in Chicago, where Mr. Charles T. Yerkes has granted permission to the Love Electric Traction Company to lay its conduit system and operate its electric motor cars. Some of the working plans are reproduced herewith, and clearly show a strong, simple and mechanically excellent conduit, the details of which are apparent to all street railway men.



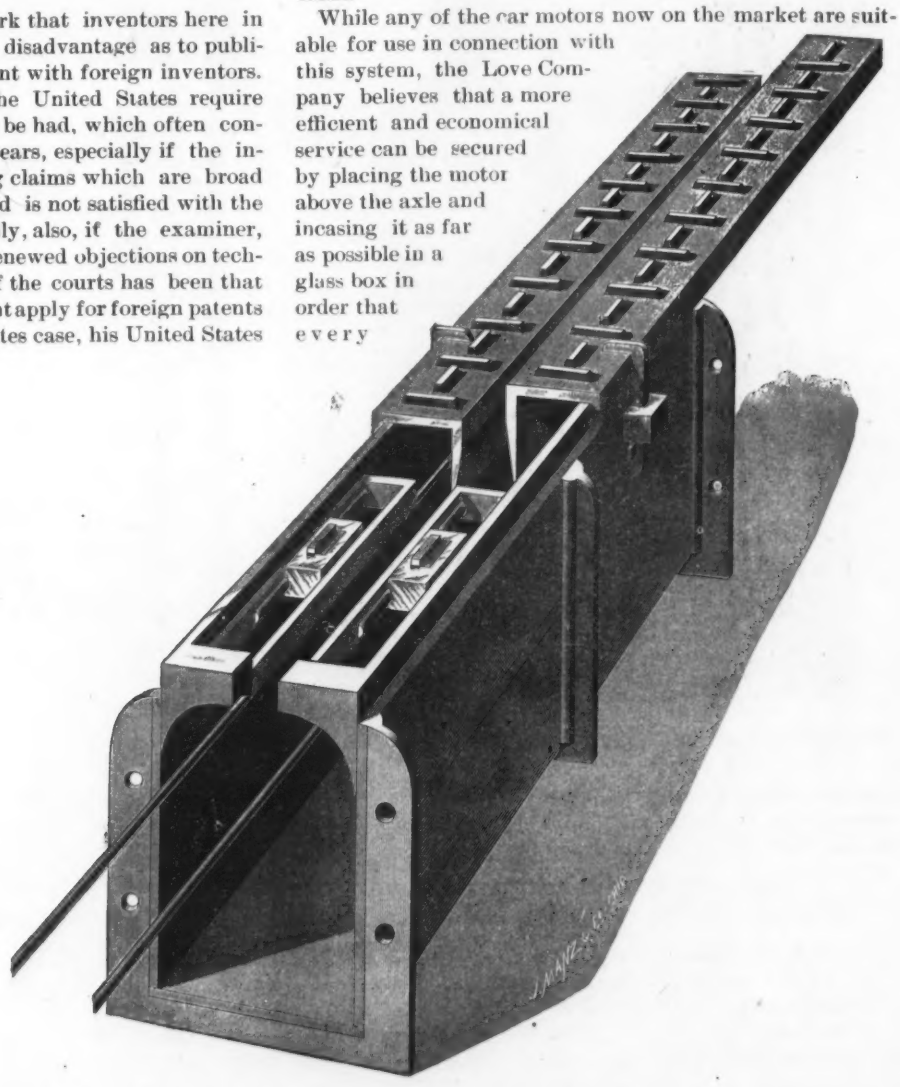
THE LOVE ELECTRIC STREET RAILWAY CONDUIT.

This conduit is but 15 inches in depth, and as the slot rails are easily detachable is readily cleaned.

The copper conductor or trolley wires form a complete metallic circuit, and are supported on oblong glass block insulators, through the centre of which the wire passes, and are keyed into the supporting edge; the copper wire is further protected by the deep flange on the slot rail.

The method of taking current from the trolley wire is fairly well shown in the annexed cut. The trolley is an ingenious device, having two contact wheels for each conductor, and so arranged by means of springs that it will press against the conductor at an ordinary angle, and is held in position by the simple lever arrangement.

While any of the car motors now on the market are suitable for use in connection with this system, the Love Company believes that a more efficient and economical service can be secured by placing the motor above the axle and incasing it as far as possible in a glass box in order that every part may be open for inspection. The company believes that the driving gear should be similar in form to that used in locomotives, thus securing the highest efficiency.



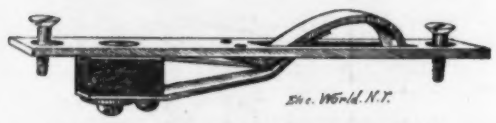
THE LOVE ELECTRIC STREET RAILWAY CONDUIT.

The loop line on which the experiment will be carried out is now operated by horses, and the number of passengers carried daily during the busy hours far exceed the averag number carried on similar lines. Again, owing to the location of the streets through which the line passes—*i. e.*, in the suburbs—the conduit will be more exposed to the ravages of dust, dirt, mud and snow than if it were located in streets cleaned daily. Thus the test will be more valuable in that respect. In any event the results will be looked forward to with great interest. The officers of the company are P. C. Hanford, president; John A. Roche, vice-president; John G. Shortall, treasurer, and Albert G. Wheeler, secretary and general manager.

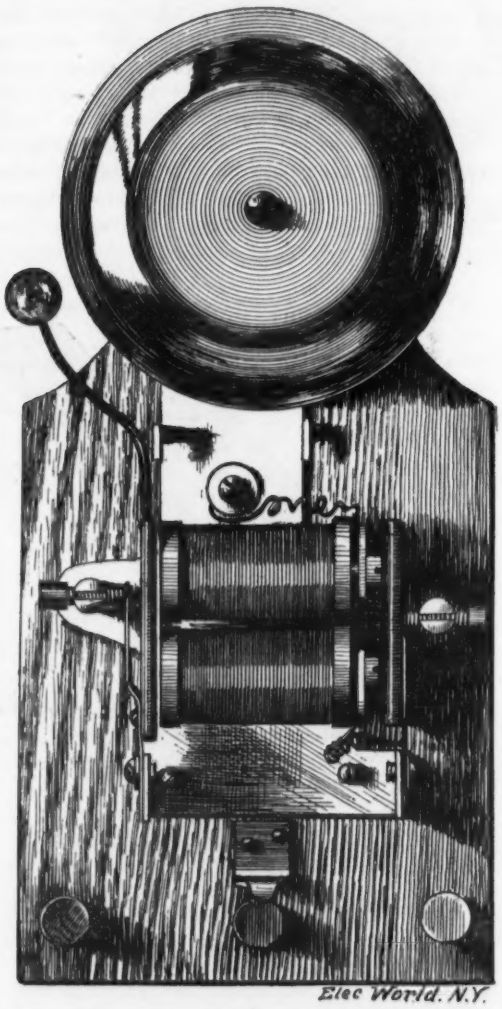
### A New Bell and Burglar Alarm Push.

The accompanying illustrations show a couple of new pieces of electrical apparatus just placed upon the mark e by the Arnold Electric Manufacturing Co., of Chester, Pa. The burglar alarm push shown in Fig. 1 is very simple in its construction and operation, and these will be readily understood from the illustration. The hinge of the push is composed of two pivots. This little appliance may be used either on a window or door, or may be placed under the carpet as a floor push.

The bell shown on this page is novel in construction, in that it has an armature at each end of the magnets, one of which acts in any given case as a yoke and the other as the armature proper. It will be noticed that the bell has three binding posts. These lead to two independent circuits, in one of which a push button operates the bell by closing one of the circuits and the second push button operates the buzzer. Of course two hammers may be used to strike bells of different tones. The frame of the bell is brass and this is attached to a wooden base. The whole construction is decidedly simple and is the first of a series that this firm is about to place upon the market.




A NEW BURGLAR ALARM PUSH




1 A COMBINED ELECTRIC BELL AND BUZZER.

### Electric Lighting in the City of London.

A London correspondent, writing under date of June 17, says: "The reproach that has frequently been made that in the public electric lighting of its thoroughfares London is far behind many of the American cities, and also in the rear of Paris, Berlin, Vienna, Milan and other continental cities, will soon be a thing of the past. The first thoroughfare to be lighted is Queen Victoria street, which is already studded with a number of arc lamps arranged on iron standards about 30 feet high. These lamps were experimentally lighted on several evenings this week, and the permanent illumination is to commence immediately.

"This is, however, not the first occasion that arc lamps have been used in the city. About 10 years ago experiments were made, but as the lighting was unsatisfactory it was discontinued. Since that time the City Commissioners of Sewers—the authority controlling the lighting, etc., of the city streets—has been considering the subject as to the general adoption of electrical illumination. It was, however, only in 1890 that contracts were entered into with the Brush Electrical Engineering Company, Limited, for the electric lighting of the central and western portions of the city, and the Laing, Wharton & Down Construction Syndicate, Limited, for the illumination of the eastern portion. At present the cost of lighting the city by gas amounts to £10,000 per annum, but with the electric light the cost will be increased to slightly more than £20,000. Though the expense will be greater, there will be at least ten times the amount of light. The three divisions of the city contain about 1,000 gas lamps of about a total of 40,000 c. p. These will be replaced by 400 arc lamps of 2,000 c. p., and 1,000 incandescent lamps, the latter being for the illumination of the small streets, lanes and courts. At the end of 21 years the City Commissioners of Sewers may acquire, if desired, the whole of the generating plant, buildings, cables, lamps, etc., used in both the public and private lighting.

"The first step toward the lighting was the laying on the 3d of February last of the first stone of the main junction box by the Lord Mayor of London, in the presence of many distinguished visitors. This junction box will be used for connecting the mains of the two contracting companies, so that in the event of an accident occurring at either of the generating stations current will still be available from the other station. Since then considerable activity has been displayed in the laying underground of the mains, some of which are laid in 4-inch iron pipes and others in troughs. The first generating station of the Laing, Wharton & Down Construction Syndicate is in course of erection on the north bank of the River Thames, between the Customs House and the Tower of London; the first station of the Brush Electrical Engineering Company is now almost finished. It is situated on the Surrey or south side of the River Thames, along the wharves termed 'Bankside.' This is about half way between Southwark and Blackfriars bridges, over both of which the cables have been carried. The area of the site is very large, and there is ample space for six stations of the size of the one now practically completed. The first installment of the plant is already in position. It comprises two Babcock & Wilcox water-tube boilers of 250 h. p. each and two 40-light Brush dynamos, which are driven by ropes from Raworth engines. Two Mordey alternators are about to be erected, together with the necessary boilers and engines, these being for private lighting. The total capacity of the station will be 16 40-arc-light machines and alternators, yielding a total output of 3,000,000 watts, or say just over 4,000 h. p. The boilers will all be of the Babcock & Wilcox type, which is now so frequently adopted in London central stations, while the engines will be of the Raworth make.

"The concessions of both companies are to be transferred to the already constituted City of London Electric Light Company and to another company yet to be formed. It is expected that the demand for light by private consumers, which is a monopoly of the companies, will be very considerable, and that the commercial prospects of the undertakings are very favorable."

### A New Vertical Compound Engine.

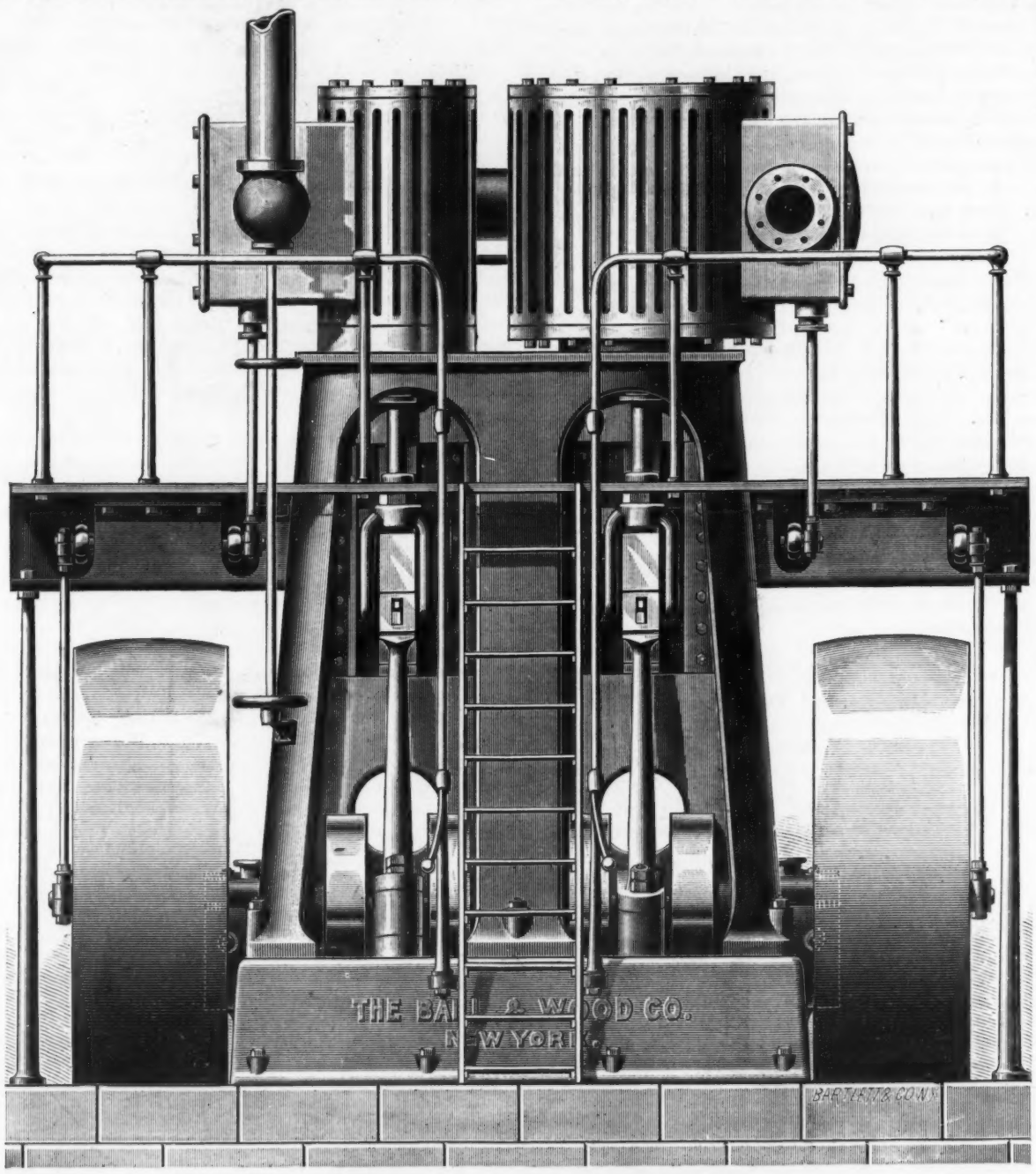
One of the interesting chapters in the history of electricity relates to the remarkable development of high-speed engines which it has caused. The slow-speed engine in its best form, the Corliss type, was practically a perfected machine when the first electric dynamos for commercial use were put into service, while the high-speed engine may be said to have developed simultaneously with the electric industry.

The earlier dynamos were almost invariably driven by high-speed engines, not only because of the better regulation thus obtained, but because Corliss engines of small power are very expensive and cumbersome. Fuel economy in the small stations then in use was of less importance than compactness of plant and uniformity of speed. As the business grew, the question of coal consumption began to receive more attention.

The advantage in economy was offset by the smaller cost of the high-speed engine, its less floor space and the small cost of a reserve unit for emergencies, together with the better regulation obtained. To meet the popular demand for more efficient engines, compound cylinders were applied to high-speed engines with the most gratifying results.

It was found that compounding was specially adapted to this class of engines, and showed a greater gain in economy than the Corliss engine. The small cost of these compounds permitted their being sold at less price per horse power than the single-cylinder Corliss, and the question of economy between the two was clearly against the Corliss in this comparison, whether both were used with the condenser or without. Thus a wider field for high-speed engines was opened. The skepticism at first expressed as to the desirability of non-condensing compounds was quickly answered by practical results. One of the notable cases of this kind is the well-known comparison of coal consumption per "ampère hour" between the station of the Edison Electric Illuminating Company, of Brooklyn, and the Edison lighting stations of New York. In the Brooklyn station non-condensing compounds are used, and the New York stations have single-cylinder engines.

The usual form for high-speed compounds is the horizontal, whether of the tandem or cross-compound type. In Europe the vertical form is extensively used, and it is by




THE BALL & WOOD VERTICAL COMPOUND ENGINE

lieved by many that large high-speed vertical compound engines will come into very general favor here, particularly where floor space is valuable.

The accompanying illustration shows a 500 h. p. engine of this class. The floor space required, including wheels, is about 8 feet × 12 feet, thus giving over 5 h. p. per square foot of floor space. The vertical height of the engine is about 12 feet above the floor.

The engine here illustrated is built by the Ball & Wood Company at its Elizabethport shops, and has in its governor, valve, etc., all the characteristic features of the Ball engines.

For convenience of access the front legs of the frame are arranged to be detached just below the gallery floor and removed entirely, thus allowing the shaft to be rolled out at the front of the engine. The rest of the frame is cast in one piece, except the guides which are placed on finished seats in the frame. Both valves are driven from crank pins instead of eccentrics, one being part of the automatic cut-off governor, and the other set in a plate arranged for an adjustable cut-off.

The rock shafts are carried in adjustable boxes placed in a bracket, one end of which is attached to the frame and the other end supported by a pillar set on the foundation. This bracket is placed under the gallery floor and forms one of its supports at each side of the engine. A movable section of floor permits ready access to the rock shafts for inspection or oiling.

## A Thomson-Houston Electric Tramway.

The demand of mills and manufactories for a safe, reliable and economical method of transporting raw materials and manufactured products about the works or to and from the railway station has led to the adoption of the electric tramway. The Thomson-Houston Motor Company, of Boston, has recently installed a tramway at the works of the Pittsburgh Plate Glass Company, of Ford City, Pa. This installation is especially interesting owing to the peculiar conditions under which it is working, and furnishes a good example of the wonderful possibilities of the application of electric power.

The purpose for which the tramway is used is transferring the immense plates of glass in process of manufacture from one part of the works to another. Four locomotives, one of which forms the subject of the accompanying illustration, are in use, each being equipped with a 20 h. p. Thomas-Houston motor. This motor is used not only to propel the locomotive, but also to drive a hoisting drum which by means of special gearing is thrown in or out at will.

A THOMSON-HOUSTON MILL TRAMWAY.

Glass is loaded on cars which run on tracks at right angles to the main track, and the hoisting apparatus above mentioned is used to pull these cars up to the tow cars, which run on the main track and are hauled by the locomotives. The tow cars are ordinary platform trucks. The grade of the main track is such that the platforms of the trucks are on a level with the side track, and the cars when loaded are placed on the trucks and then transferred to any desired point.

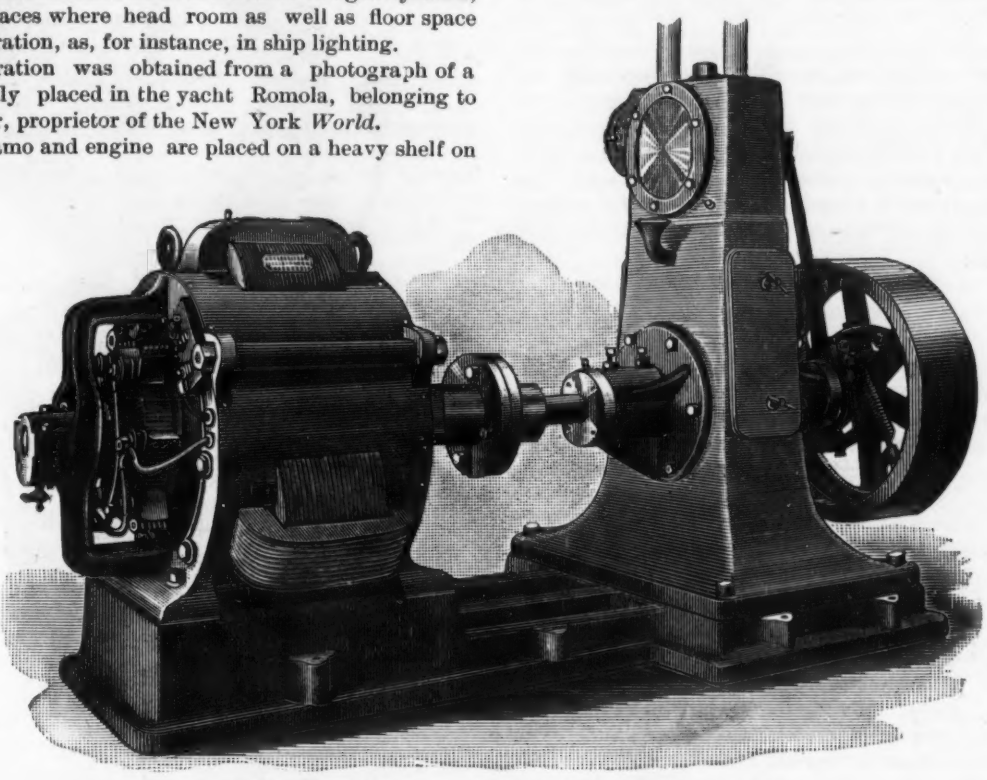
There are two lines of main track, both of which are entirely inside the works, and each of which is about 700 feet in length. The gauge of the road is nine feet and ten inches, which is probably the broadest gauge ever used in tramway work. The overhead single-wire construction is used and the current for the operation of the motor car is generated by a 500-volt Thomson-Houston generator.

## Combined Case Engine and Perret Dynamo.

We illustrated in a recent issue a high-speed Case bracket engine, placed on the wall, and belted to a low-speed Perret dynamo on the floor beneath, the pulleys of engine and dynamo being large and of about the same diameter, showing an admirable way of economizing floor space. On this page is shown a Case pedestal engine coupled to the armature shaft of a Perret 85-light dynamo, for use in places where head room as well as floor space is a consideration, as, for instance, in ship lighting.

The illustration was obtained from a photograph of a plant recently placed in the yacht Romola, belonging to Mr. Pulitzer, proprietor of the New York *World*.

The dynamo and engine are placed on a heavy shelf on one side of the engine room, and supply light throughout the yacht, which is 170 feet long, and also current to a storage battery used for lighting when the engine is not running. The speed of the combination is 585 revolutions per minute, and everything is in such perfect balance that there is practically no vibration. The dynamo is of course waterproof and has the Perret self-adjusting brushes. The plant was constructed and installed by the Elektron Manufacturing Company, 79 Washington street, Brooklyn.



COMBINED PERRET DYNAMO AND CASE ENGINE.

## Early Reading of Telegraph Messages by Sound.

BY AN "OLD TIMER."

The letter of Hon. Elijah Paine to Prof. Samuel F. B. Morse, and the reply in fac-simile, published in THE ELECTRICAL WORLD of May 23, 1891, cannot possibly refer to what is known as the "reading by sound" of telegraphic messages; much less can it be considered the origin of any system of reading by sound, because it was never accepted by Prof. Morse, never pursued by Elijah Paine, and never adopted by any one else.

The dates of the correspondence referred to are only just at the opening of the first experimental public line between Washington and Baltimore, and the first public messages over that line. That correspondence refers entirely to the manner in which the telegraphic alphabet should or could become fairly readable, and contemplated a scheme which was never anywhere employed. The mention in the letter of Prof. Morse of reading by sound only refers to the reading by sound of the single-letter office call, or, at most, the office call of two letters then in use and in use to-day.

Neither Prof. Morse, his electrical assistant, Alfred Vail, nor any of their operators, prior to the middle of 1846, ever attempted or suggested the reading by sound of any message. The paper of the recording register was the only accepted plan, and it remained upon the statute book of the New York, Albany & Buffalo Telegraph Company as the only permitted plan, as late as 1854. This line was the nearest to Prof. Morse's home, and he was a principal owner and director of it: and Mr. Otis E. Wood was still superintendent of that line in that year; and he had labored assiduously, but without favorable result, for eight years against the conservatism of a New York State Board of Directors to have sound reading permitted in receiving messages. It was, however, upon this line that reading by sound was originated and its knowledge came to the public, as shown in the extract below. Early in the autumn of 1846 Hon. Ezra Cornell opened this line from New York to Albany in office quarters in Post's Buildings, behind Merchants' Exchange, New York, alongside of the Boston line, opened a short time before. Mr. Geo. B. Prescott was then first assistant operator of the Boston line, and Mr. Otis E. Wood first assistant operator of the Albany line, at the above joint office.

Within the same three months occurred the circumstance which Mr. Geo. B. Prescott mentions in his "History, Theory and Practice of Telegraphy," published in 1866, pages 340 and 341. In his article, "Reading by Sound," he says:

"The first time, however, we saw any one read in this manner was in the winter of 1846-7, in New York. The lines were broken, and Mr. O. E. Wood and ourself were sent out to repair them. Mr. Wood carried a small electro-magnet in his hand, and when we reached Harlem Bridge he disconnected the line wire and attached it to one end of the helix wire, and then, uncoiling a dozen or two feet of iron wire, dropped one end of it in the river, and with the other commenced tapping upon the other extremity of the helix wire. To our infinite astonishment we saw the lever fly backward and forward: and presently, when he had stopped writing, he received a reply from the office in New York."

The Morse lines west from Buffalo, however, succumbed, about 1850, to the demand of their operators, and were the first generally receiving telegraphic messages by sound as now everywhere practiced.

[Had the writer of the above communication read the paragraph immediately preceding the one he has quoted from Mr. Prescott's work, he would have found this sentence: "We shall not pretend to say to whom is entitled the credit of having first discovered the idea of reading by sound." This would seem to indicate beyond a doubt that Mr. Prescott believed the idea of reading by sound to be of much earlier origin than the date of the incident mentioned in the passage quoted as occurring in the winter of 1846-7, although this method of reading messages was for commercial reasons not generally adopted by the telegraph companies until many years later. As to the statement made by our correspondent that the letters printed in THE ELECTRICAL WORLD of May 23 "cannot possibly refer to what is known as the reading by sound of telegraph messages," a sufficient refutation would seem to be found in the following passages taken from Prof. S. F. B. Morse's "Report on Telegraphic Apparatus, etc.," exhibited in the Paris Exposition in 1867. This report was published in

1869. In it Prof. Morse says in regard to sound reading instruments:

"The first acoustic semaphore using the Morse code was the original recording instrument shown by the writer in 1835, at which time this acoustic peculiarity was not only noticed, but was then made known to others, and was considered of sufficient importance to be secured by letters patent drawn up in 1837. The claim therein is for a mode of communicating intelligence 'by signs and sounds, or either.'"

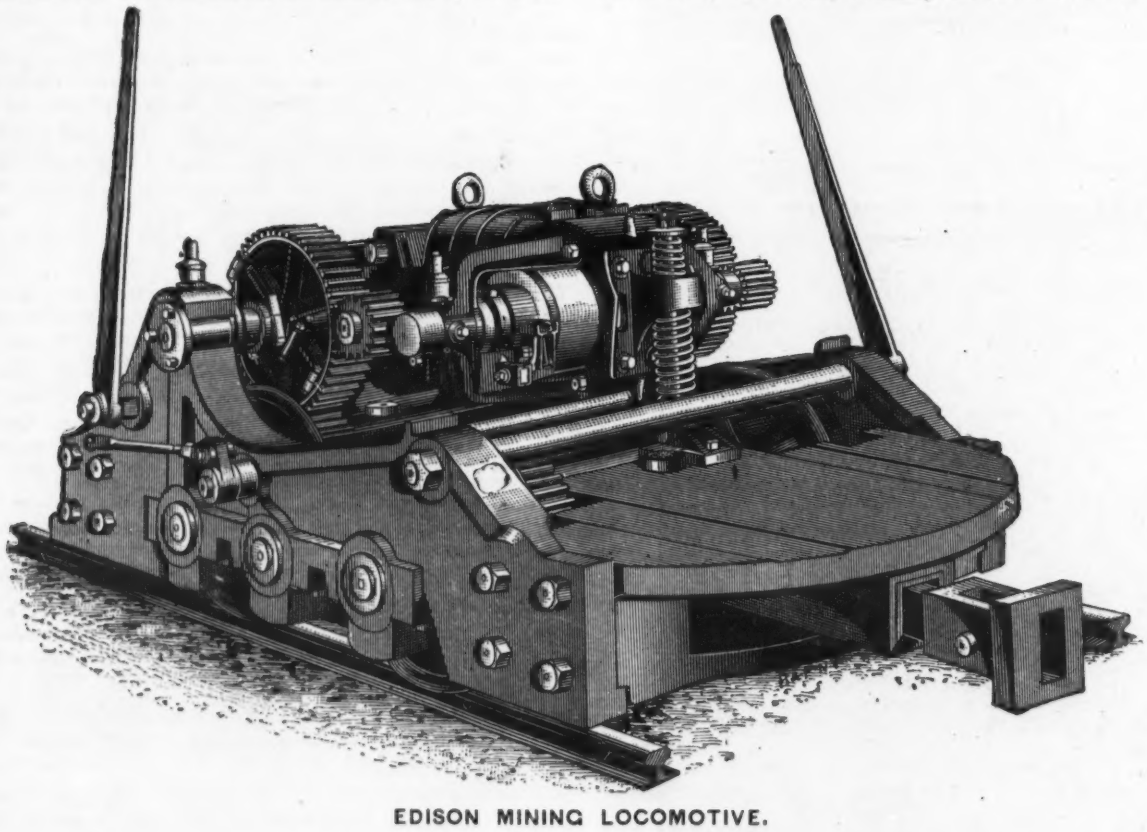
The same report contains what is called "Morse's organ pipe sounder," which, as is shown by the correspondence of Elijah Paine and Prof. Morse, was first suggested to the latter in 1844 by Judge Paine. This description establishes the fact that the correspondence of these men did refer to what was considered "a system of reading by sound," not office signals merely, but messages, and that Prof. Morse worked out this system in 1845. This apparatus is described in these words:

'One of the modifications by Morse himself, experimented upon by him as early as 1845, gives the sound of each letter of the Morse code more accurately than any yet devised: and although not practically adopted, because of the great advantages of the written mode in simplicity of apparatus, is yet perhaps worthy (at a time when the acoustic method is received with favor) to be revised and made practical, at least so far as to satisfy curiosity. The method devised by him was by an organ pipe so connected with a small bellows as to be opened and closed by a pen lever in the act of writing a dot or a dash. It is at once obvious that in indicating a dot the pipe would give a short, sharp sound, but in indicating a dash the sound would be correspondingly prolonged. The short and long intervals, therefore, by which the dot and the dash are now distinguished in the ordinary acoustic instruments are by this method more completely expressed, reducing the code to *musical expressions*—to crotchets and semibreves. The disadvantage which suggests itself is the necessity of a bellows apparatus for a constant supply of air to the pipe, adding materially to the complication of the machinery; and has also the inconvenience just alluded to, by its loudness (which indeed might easily be moderated), of confusing the ear where many instruments are within hearing of each other."—ED. E. W.]

### A New Electric Bell.

This bell is simple, compact, and contains many desirable features, among which are the shape and position of the magnets, which give the maximum power with the minimum of battery force. It is said that with one cell of battery this bell will ring through from 600 to 800 feet of No. 18 wire, and for any ordinary call but one cell of battery need be used. The hammer and armature are made from a single punching, which is copper plated to prevent rusting. These bells are manufactured by the Western Electric Company, of Chicago, and each one is thoroughly tested and adjusted before shipment.

ELECTRIC BELL.



EDISON MINING LOCOMOTIVE.

### Electric Mining Locomotive.

The accompanying illustration shows a 15 h. p. mining locomotive built by the Edison General Electric Company. In its construction care has been taken to distribute the weight so that all four wheels will bear evenly, a feature which insures a maximum traction where both axles are driven from the same motor, and which otherwise contributes to the perfection and economy of the machine.

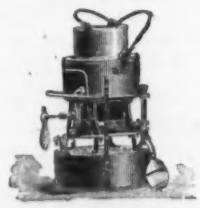
The motor itself is well protected by a wood housing so arranged as to give ready access to the commutator and brushes by the simple lifting of a slide; and by removing four bolts and raising the main cover the whole motor is exposed to view and its various parts are thrown open to inspection.

By this arrangement the motor is thoroughly protected—a feature of the utmost importance, especially in mine work, and at the same time access to the working parts is readily gained without recourse to the tedious operations required by enclosed motors.

On the smaller machines of this type a 15 h. p. motor is used, one end of which is hung to a support on the frame, and the other flexibly suspended after the regular manner found so efficient in street railway practice. In this, as in the 10 h. p. locomotive, the motor is connected to both axles by direct gearing.

### An Electrical Soldering Furnace.

Among the numerous tools brought out for the use of the electrical workman perhaps none has more interest for the average lineman than that shown in the accompanying illustration, except, perhaps, his pocket cutting pliers.



ELECTRICAL SOLDERING FURNACE.

This soldering furnace is manufactured by the Burgess Soldering Company, of Columbus, O., and is fitted with the company's slotted cast-iron cylindrical burner. The fact that the furnace is recessed at both the back and front is claimed by the company to insure perfect safety and great durability for it. It is also claimed that the heat is distributed through the whole length of the soldering iron It is provided with a sliding cut-off and drip cup, the knob of which is always cool. The burner is so arranged that the solder cannot fall through into the large perforations and shut off the flame. The total weight of the furnace is 13 pounds. The reservoir is fireproof, and cannot be filled while the torch is burning. The total height of the furnace is 11½ inches, and it has been designed especially for the use of linemen in the melting of lead and the soldering of wires.

# Financial Intelligence.

## THE ELECTRICAL STOCK MARKET.

**Bell Telephone Output.**—The statement of the company for the month ending June 20 is as follows:

| | 1891. | 1890. | Inc. | Dec. |
|---|---|---|---|---|
| Gross output | 8,211 | 7,758 | 453 | ..... |
| Returned | 2,667 | 1,927 | 740 | ..... |
| Net | 5,544 | 5,831 | .... | 287 |
| Since Dec. 21: | | | | |
| | 1890-91. | 1889-90. | Inc. | Dec. |
| Gross | 37,924 | 33 577 | 4,347 | ..... |
| Returned | 18,761 | 12,104 | 6.657 | .. .. |
| Net | 19,163 | 21,473 | ... .. | 2,310 |

**Thomson-Houston.**—The Boston *Herald* says: "The Thomson-Houston management is not as yet considering the general plan of issuing a new series or a new block of bonds under the auspices of the United Securities Company, but is likely to do so later. The company's railway business is ahead of last year, and there are important negotiations pending for large orders. It now turns out a dozen motors per day. Developments by the International company abroad are extensive. English parties are raising $250,000 and taking an option to do an electric-railway business in Great Britain. This is to start the business, and if the promise is good an undertaking upon a larger scale is likely to follow. Wealthy German parties have secured a short option, and purpose to organize a company to do an electric manufacturing business in northern Europe under Thomson-Houston patents. The International company has found its best field thus far in Central and South America. One contract has been made for $125,000 to equip a railroad at Rio Janeiro, and the matter is under advisement of extending the application of electricity to the half dozen or thereabout street railways in that city.

**Westinghouse.**—The adjourned meeting of the company was held at Pittsburgh on Tuesday of last week. The following statement was presented by Vice-President Bannister, explanatory of the adjournment and of the progress of the reorganization: "Mr. Westinghouse, the president of the company, is unable to be here to-day, as he is detained in the East in connection with matters relating to this reorganization. The work of carrying the reorganization has progressed very satisfactorily. It has met with approval in every quarter, and almost three-fourths of the company's stock has assented to the plan, and we have assurances that the greater part of the remaining stock will be deposited with the Mercantile Trust Company of New York very soon. We had hoped to have all necessary action taken by this meeting, so that no further adjournment would be necessary; but owing to the fact that Mr. Westinghouse and several others whose presence is necessary could not be here to-day, and the desirability of having everything in shape before the final action is taken, we suggest that an adjournment be taken until Wednesday, July 15, at 10 o'clock in the forenoon, at this place. We expect that by that date all arrangements necessary will have been completed." The reorganization committee, composed of August Belmont, Charles Fairchild and Brayton Ives, issued on June 24 the following announcement: "Inasmuch as holders of considerably more than two-thirds of the stock of the Westinghouse Electric and Manufacturing Company have assented to the plan of reorganization, the reorganization committee have decided to limit to July 8, 1891, inclusive, the time in which stockholders may deposit their stock with the Mercantile Trust Company, of New York. Notice is hereby given that after that date stock will only be accepted subject to such additional conditions as the committee may impose."

**The Closing Quotations** of electric stocks, from F. Z. Maguire & Co., electrical securities, 18 Wall street, New York, on Saturday, June 27, 1891, in New York, Boston and Washington, were:

| Name of Stock. | Par. | Capitalization. | Bid. | Ask'd. |
|---|---|---|---|---|
| NEW YORK. | | | | |
| Western Union Telegraph Co | 100 | 86,200,000 | 78⅞ | .... |
| American Telegraph & Cable | 100 | 14,000,000 | .... | 80 |
| Central and South American | 100 | 5,000,000 | 130 | 140 |
| Mexican | 100 | 2,000,000 | 200 | 215 |
| Commercial Cable Co | 100 | 7,716,000 | 104 | 105 |
| Postal Telegraph Cable | 100 | 5,000,000 | 28 | 32 |
| Edison General Electric Co | 100 | 9,503,500 | .... | .... |
| " " Deferred | 100 | 2,496,500 | .... | .... |
| Consolidated Electric Light | 100 | 1,929,400 | .... | .... |
| Edison Electric Illuminating Co | 100 | 2,567,800 | 76 | .... |
| United States Electric Light | 100 | 1,500,000 | 30 | .... |
| North American Phonograph | 100 | 6,200,000 | .... | .... |
| BOSTON. | | | | |
| Thomson-Houston Electric Co | 25 | 6,000,000 | 41½ | 42 |
| " " preferred | 25 | 4,000,000 | .... | .... |
| " " Series C | 10 | 400,000 | ... | ... |
| " " Series D | 10 | 120,000 | 7 | 7¼ |
| " International Co | 100 | 1,000,000 | .... | .... |
| Thomson Welding Co | 100 | 1 000,000 | .... | .... |
| " European Welding Co | 100 | 1,000,000 | .... | .... |
| Ft. Wayne Electric Co | 25 | 4,000,000 | 11⅞ | 12 |
| Westinghouse Electric Co | 50 | 5,000,000 | 12 | 12½ |
| Detroit Electric Works | | | ... | .... |
| Telephone: | | | | |
| American Bell | 100 | 12,500,000 | .... | 200 |
| Erie | 100 | 4,800,000 | 48 | 49 |
| New England | 100 | 10,304,600 | 50 | .... |
| Mexican | 10 | 1,280,000 | 1.17½ | 1.25 |
| Tropical American | 10 | 400,000 | 80c. | 90c. |
| Edison Phonograph Doll | 10 | 1,000,000 | .... | 75c. |
| WASHINGTON. | | | | |
| Pennsylvania Telephone | 50 | 750,000 | 24 | .... |
| Chesapeake & Potomac | 100 | 2,650,000 | 62 | 65 |
| American Graphophone | 10 | 600,000 | 5¾ | 7 |
| United States Electric Light (Washington) | 100 | 300,000 | 155 | 160 |
| Eckington and Soldiers' Home Electric Ry | 50 | 352,000 | 49½ | .... |
| Georgetown and Tennallytown | 50 | 200,000 | 57 | 65 |

**Chicago Quotations.**—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

| | | | |
|---|---|---|---|
| Chicago | $230@$240 | Cumberland | $60@ $62 |
| Central Union | 51@ 55 | Wisconsin | 118@ 120 |
| Michigan | 84@ 85 | Bell of Missouri | 160@ 165 |
| Great Southern | 30@ 32 | Iowa Union | 20@ 22 |
| Colorado | 31@ 36 | Missouri and Kansas | 54@ 56 |
| Rocky Mountain Bell | 40@ 43 | | |

ELECTRIC LIGHT STOCKS.

| | | | |
|---|---|---|---|
| Chicago Arc Light and Power | $100@$101 | Chicago Edison Co | $145@$150 |

## AFFAIRS OF THE COMPANIES.

**The People's Edison Electric Illuminating and Power Company** held its annual meeting recently. The following officers, etc., were elected: President, Henry L. Greene; Vice-President, John H. Campbell; Secretary, Edw. F. Carrigan, and Treasurer, Edw. Pike. The directors are Henry L. and Frank W. Greene, Robt. Reach, S. A. Douglas, Jos. B. Holmes and Frank M. Tucker.

## NEW INCORPORATIONS.

**The Marion (Ill.) Electric Light and Street Railway Company** has been incorporated, with a capital stock of $20,000. The incorporators are Messrs. J. C. Mitchell, Wm. H. Warder and W. H. Bundy.

**The Parlor Electric Company,** of Paxton, Ill., has been incorporated with a capital stock of $2,100, for carrying on electric light and power. The incorporators are C. H. Langford, J. L. Larkin and H. B. Henderson.

**The Pana (Ill.) Modern Electric Light, Power and Street Railway Company** has been incorporated, with a capital stock of $50,000. The incorporators are Messrs. J. W. Stokes, A. B. Corneau and J. Hirbin.

**The Morgan Park and Pullman Electric Street Railway Company,** of Chicago, Ill., has been incorporated with a capital stock of $250,000, to construct and maintain a street railway. The incorporators are George W. Todd, J. H. Westover, W. W. McDonald, F. S. Wheaton and John A. Roach.

# Special Correspondence.

## NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, June 29, 1891.

**Mr. C. G. Perkins,** of Hartford, Conn., well known as the inventor of various electrical specialties bearing his name, was in New York City this week and everybody was glad to see him.

**Messrs. Truex & Vail** have been very successful in the introduction of the swinging ball lightning arrester. In a letter received by them recently, the Elizabeth (N. J.) Schuyler Electric Company writes that during a recent storm a circuit recently run for power, and protected by other protectors, was burnt out, while those circuits where the "swinging ball" was in use were not harmed in the least.

**Col. Mitchell,** of the Giant Car Mover Company, 5 Bowling Green, New York City, is introducing a new composition for journal bearings which has great merit. The composition has been applied to steam railroad cars, to trucks and to motors running heavy fans, and in each instance it is doing excellent work. It would seem that for electric street car work the new composition would be most valuable.

**The Scott Electric Company,** of 26 Liberty street, is very busy manufacturing the celebrated Huntington search light. Recent installations have been the U. S. steamer Armenia, the C. H. Northam of the New Haven line, upon the Canadian Pacific Railway, and Kiralfy's new summer resort on the Palisades in New Jersey, one search light and four electro calciums. The company has also placed a search light on top of the 13th Regiment armory for signaling Morse, using the government code.

**Association of Edison Illuminating Companies.**—The secretary of this association, Mr. W. J. Jenks, has sent a notice to all the members announcing that the next annual meeting of the association will be held in New York City, or at some point within easy reach, and will commence on the second Tuesday in August, the 11th. It is announced that the officials of the Edison General Electric Company intend to contribute to the interest of the meeting by arranging for visits to the Schenectady and other works of the Edison company.

**The Electrical Car Brake Safety Attachment Company** has been incorporated, with headquarters in New York City. This company will push certain inventions, including patent rights on an attachment for brakes on electric cars. The improvements consist in such mechanisms as will enable the motor-man of an electric car, when he applies the brake, to automatically cut off the power simultaneously with the mechanical stoppage of the car. The officers of the company are well-known steam railway men, connected with the largest corporations in America. They are: R. Tenbroeck, president; M. C. Roach, vice-president; Henry B. Jogoe, secretary, and M. J. McBride, treasurer.

**American Institute of Electrical Engineers.**—The following persons were elected associate members at the council meeting June 26: John H. Barnard, general manager Asheville Street Railway Company and Asheville Light and Power Company, Asheville, N. C.; Henry B. Cram, treasurer Bernstein Electric Company, 175 Prospect street, Cambridgeport, Mass.; Frank L. Dame, superintendent Vancouver Electric Railway and Light Company, Vancouver, B. C.; Charles Edward Emery, consulting engineer, 22 Cortlandt street, New York; Thomas J. Fay, Maine Electric Improvement Company, 136 Liberty street, New York; Walter C. Fisk, manager Bernstein Electric Company, 620 Atlantic avenue, Boston, Mass.; John L. Gans, superintendent and electrician, The Electric Company, Connellsville, Pa.; Warren B. Hadly, superintendent wiring department Edison Electric Illuminating Company, 431 Fifth avenue, New York; Louis W. Healy, the Wightman Electric Company, 1,205 Marion street, Scranton, Pa.; James W. Kellogg, assistant to district engineer, Edison General Electrical Company, 140 East Twenty-seventh street, New York; Thatcher T. P. Luquee, assistant in surveying and practical mining, and student in electrical engineering, Columbia College, N. Y., and Bedford, N. Y.; Thomas Reeve Rosebrugh, lecturer in electrical engineering, School of Practical Science, Toronto, Ont.; Giles Taintor, assistant electrician, New England Telephone and Telegraph Company, 7 Walnut Street, Boston, Mass.; Herbert C. Wirt, electrician, marine department Thomson-Houston Electric Company, 12 Millmont street, Roxbury, Mass.; Francke L. Woodward, student in electricity, 49 Grand street, Albany, N. Y. Jesse M. Smith, consulting engineer in mechanics and electricity 36 Moffatt Block, Detroit, Mich., was transferred from associate to full membership. L. H. H.

## NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.,
BOSTON, Mass., June 27, 1891.

**Mr. R. E. Morton,** superintendent of the Gloucester Street Railway, was in town on Wednesday.

**Messrs. I. S. Spencer & Sons,** of Guilford, Mass., are quite busy and are having a large run on their elegant line of push buttons.

**The New England Telephone and Telegraph Company** will move into its new operating room in the ninth story of the American Bell Telephone Company's new building at the corner of Milk and Oliver streets on or about July 4.

**Mr. J. Edward Wallace,** manager of the railway department of the Eastern Electrical Supply and Construction Company, has started on a trip through the South and West. Mr. Wallace is an energetic worker, and many and large are the orders he sends in.

**The Boston Electric Club** last week, at a regular meeting, voted to issue bonds, not to exceed in amount $5,000, to fund and pay its indebtedness. The bonds are to be issued under the approval of the executive committee. Mr. H. B. Cram presided and R. F. Ross acted as secretary.

**The Holtzer-Cabot Company,** owing to the large increase in its business and the pressing need for more room, has leased the premises at 92 Franklin street, Boston, Mass., and will move there on or about July 1st. The first floor, which has been elegantly fitted, will be used for offices, and the second floor as a stock room.

**The Consolidated Electric Manufacturing Company,** of which Mr. Chas. E. Bibber is general manager, has increased its force of employés and is now prepared to make almost everything in the electrical line. The amount of the orders taken by Mr. Bibber on his first trip after connecting himself with this company exceeded the business done the previous year.

**Mr. Elliott O. Johnson,** the popular salesman for the Redding Electric Company, was married to Miss Alice B. ..lough at the St. Stephen's Memorial Church in Lynn, Mass., last Wednesday night. The presents were numerous, many of them coming from the friends of Mr. Johnson in the electrical business. Mr. and Mrs. Johnson, after the reception, immediately started on their wedding journey, which will probably include a trip to Europe.

**City Hall Lighting.**—The lighting of the city hall in Portland, Me., by means of an isolated plant to be operated by the city, is being agitated. An expert who made an examination of the building thinks that the plant could be installed at a cost of about $8,000. Those who are interested in the scheme assert that by means of such a plant the city could save from $1,200 to $1,500 a year.

**The Sessions Foundry Company,** of Bristol, Conn., has added to its force of employés and is receiving a generous share of patronage. The goods manufactured by this enterprising concern are of the best quality and workmanship, as its many customers testify. By conscientious attention to the wants of the business and to the most minute details the company built a large trade and is meeting with great success. The Sessions company employs the best of workmen and is surrounded with every facility.

C. A. B.

## PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY TRUST BUILDING, PHILADELPHIA, June 27, 1891.

**Mr. G. H. Almon,** of the Thomson-Houston Electric Company, at Boston, Mass., read a most able paper at the last meeting of the Franklin Institute, on lightning arresters, their uses, and the various makes and types.

**The Heisler Electric Light Company,** of Philadelphia, has secured the contract for an incandescent electric light plant at West Toronto Junction, Canada. This company has also sold a plant for Morrilton, Ark.

## WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, June 27, 1891.

**Mr. C. D. Crandall** has succeeded Mr. A. C. Brown in the management of the Western Electric Company, Chicago.

**Mr. Fred. Bosson,** formerly manager of the Northern Thomson-Houston Company, of Marquette, Mich., has accepted the appointment of electrician in chief at the Calumet and Hecla mines.

**Mr. Frank Wunder,** of The Rookery, Chicago, Ill., has sold two 50 arc-light dynamos and several machines of similar sizes during the month, and expects to close several other deals in the next two weeks.

**The Electrical Supply Company,** so long at 171 Randolph street, Chicago, is now located at 102 and 104 Michigan avenue, in the five-story and basement building, corner of Michigan avenue and Randolph street.

**Mr. J. E. Hockett** has recently been appointed general manager of the Card Electric Motor and Dynamo Company, of Cincinnati, O., vice Mr. H. H. Walter, resigned. This company seems to be in a most flourishing condition on account of the largely increased demand for the Card motor. The company, it is understood, is contemplating increasing its facilities within the next 60 days.

**Mr. A. T. Ide,** of Springfield, Ill., while in Chicago en route home from the engineers' meeting at Providence, R. I., mentioned the large number of orders received for Ideal engines, especially from electric street railway and lighting companies. Mr. Ide believes that a prosperous business will be done this year by both engine and street railway manufacturing companies, the outlook being exceptionally good.

**Mr. Horatio S. Conner,** for some years past with the Brush Electric Company as traveling representative, and also as an electrical engineer, and who has had an extended experience in the installation of electrical apparatus for mining duty, will establish his headquarters in Salt Lake City, Utah, about July 1, and there represent the Excelsior Electric Company, of New York, carrying a complete line of the Hochhausen apparatus.

**Edison Appropriation for the Fair.**—It is reported that the Edison interests have set aside $250,000 for the purpose of having an adequate exhibit of the Edison inventions at the Columbian Exposition. The sum of $100,000 was laid out for similar purposes at the Paris Exposition, and judging from the success of the Edison exhibits there we may look for something startling at the Chicago Fair. The kinetograph will most likely play an important part.

**The Pasadena Electric Railway,** which we reported recently to be built from Pasadena, Cal., to the summit of Wilson's Peak, one of the Sierra Madre Mountains, directly back of that city, is to be completed within a year. The line will be 12 miles long and will attain an altitude of 6,000 feet. Surveys show that the road can be built with but one tunnel and five or six bridges, the longest of which will be but 250 feet. The construction of the road will probably be somewhat similar to that of the Pike's Peak Railway.

**Mr. J. H. Rhotchamel,** president of the Columbia Incandescent Lamp Company, of St. Louis, Mo., was in Chicago this week en route home from an extended trip to the East, during which he appointed several agents and also secured some very handsome orders for the Columbia lamp. In fact, so cordial has been the welcome everywhere extended to the Columbia lamp that Mr Rhotchamel has arranged to add to his already large force of employés. Messrs. Parmly, Mitchell & Co., of the Telephone Building, New York City, have secured the agency for the New York district, and they will certainly let nothing prevent the Columbia lamp from becoming a familiar synonym of excellence and efficiency in the minds of all users of incandescent lamps. In Boston and the vicinity the well-known Redding Electric Company, of 41 Federal street will supply both trade and consumers with Columbia lamps. An agent for Chicago and the Northwest will probably not be appointed before July.

**Chicago Visitors.**—Among the out-of-town visitors in Chicago during the week were F. C. Tyson, of the Kartavert Manufacturing Company, Wilmington, Del.; J. H. Rhotchamel, president of the Columbia Incandescent Lamp Company, St. Louis; William Bracken, president of the Consolidated Electric Storage Company, New York; C. A. Baker, Jr., of Baker & Co., Newark, N. J.; A. T. Ide, of Springfield, Ill.; H. S. Conner, of Salt Lake City, Utah; John R. Markle, president of the Electrical Fiber Carbon Company, Detroit; F. H. Leonard, manager of the Electric Engineering & Supply Company, Syracuse, N. Y.; Mr. J. P. Quaide, treasurer of the National Conduit Manufacturing Company; Mr. Wm. Bracken, president of the Consolidated Electric Storage Company, and Mr. Clift Wise, of the Interior Conduit and Insulation Company, all of New York City; Mr. Jos. Rosenstam, representing Lewisohn Brothers, New York; Mr. J. H. Finney, of the Northwest Thomson-Houston company, St. Paul.

**The Columbian Exposition.**—Chief Barrett will shortly visit the manufacturers of electrical apparatus throughout the country and arrange for the character of the display, and the amount of space to be occupied, and location. Mr. Barrett will be accompanied by Frederick Sargent, and will have detailed working plans of the electrical building, showing exactly the arrangement of space at their disposal. Over two hundred applications have been made for space, but none has yet been assigned. On Wednesday Chief Barrett signed the appointment of Mr. E. E. Keller as assistant to the chief. Mr. Keller is well known throughout the West as an honorable, capable and efficient engineer; was born in New York City in 1863 and passed his boyhood in Rochester, N. Y. After working his way up as mechanic, draughtsman, etc., he was in 1888 made manager of the Chicago office of the Keystone Construction Company, and when that company was merged into the North American Construction Company he retained the position of manager, and during the occupancy of the office planned and constructed some twenty odd electric stations. When the North American company closed its office Mr. Keller accepted a position with the Fort Wayne Electric Company, which position he resigned on Monday. Hereafter he will have an independent office in The Rookery, where he will supervise general engineering work during his spare hours. Chief Barrett made the appointment at the suggestion of Mr. F. S. Terry, and it is looked upon as an unusually fortunate one.

**The Hyde Park Thomson-Houston Light Company.**—When Hyde Park became annexed to Chicago—less than two years ago—it was not blessed with electric lights. To-day it has one of the neatest and most complete central station plants in the country, and the greater portion of its incandescent load is utilized in lighting the beautiful residences that adorn that portion of the city. The station, a fine brick structure, is located at 87 and 89 Fifty-third street, near the lake shore, and is divided by a fire wall into large rooms. The furnace room contains two Murphy smokeless furnaces with Roney stoker and patent damper regulator, Dean pump, Baragwanath feed-water heater, Pond steam separator, Lyman exhaust head, and a water tank of sufficient capacity for a twelve hours' run, should any accident happen to the city supply of water. The coal used costs $1.25 a ton, laid in the furnace room. The dynamo room is nicely finished in hard woods and contains two 30-light Thomson-Houston arc dynamos and two 1,500-light alternating incandescent machines, all manufactured by the Thomson-Houston Electric Company. These dynamos are connected directly to two McIntosh & Seymour triple expansion engines of 150 h. p. each, by Page, Jewell & Munson belting. The switchboard is the latest form of open lattice work, and contains the improved automatic cut-outs, lightning arresters, etc. The circuits are carried from the switchboard to the distributing tower on the roof through porcelain cleats, the wire nowhere coming in contact with wood. The pole line circuit is worthy of much praise, being strongly and handsomely built of selected poles ranging from 40 feet to 65 feet in height, and carrying two, four and five cross arms. Over 50 miles of Simplex wire has been strung, and each and every circuit is in excellent condition. In building the pole line, the circuits running north and south were erected in the alleys, only the east and west circuits running on the streets. Mr. Edward C. Loveland is the general superintendent of the company, and the board of directors is composed of the following gentlemen, who are well known in Chicago: J. W. Brooks, Jr., president; H. N. Hibbard, vice-president; E. C. Ward, secretary and treasurer; O. F. Lindman, J. H. Ware, C. B. Bouton and F. E. Spooner. F. DE L.

PORTLAND, Ore., June 22, 1891.

**The Albina Light and Water Company,** of Albina, Ore., has just purchased of the Northwest Thomson-Houston Electric Company, of Portland, Ore., several arc machines, to be used for local street lighting.

**The Willamette Bridge Railway Company's** street car lines in Portland will soon be equipped with electricity. The above company has already purchased of the Portland branch of the Northwestern Thomson-Houston Electric Company fifty motors for car equipment. This, when completed, will be one of the finest street car lines in the city.

**The Pacific Northwest District** of the Edison General Electric Company has just consummated a deal with the city of East Portland, Ore., for one hundred arc lights for lighting the streets. Since ordering the one hundred lights another order has been placed for fifty lights additional. East Portland will have a fine plant when completed. The same electric company will furnish generators for capacity of 2,000 h. p. to the Union Power Company of Portland. These generators will be used for furnishing power for electric street railways and other machinery where electricity can be used. R. T. O.

## SOUTHERN NOTES.

NORFOLK, Va., June 27, 1891.

**Austin, Tex.**—The Austin Street Railway Company will equip its lines with electricity.

**Waxahachie, Tex.**—The Lake Street Railway Company is to operate its lines by electricity.

**Scotland Neck, N. C.**—It is reported that an electric light plant will be established here soon.

**Hallettsville, Tex.**—The city has let the contract for a system of electric lights to be installed at once.

**Grafton, W. Va.**—The Grafton Electric Light and Gas Company will, it is reported, double its capacity.

**Pasadena, Fla.**—It is reported that T. S. C. Lowe and others will build and operate an electric railroad here.

**Houston, Tex.**—Permission to build additional tracks has been allowed the Houston Electric Street Railway Company.

**El Paso, Tex.**—The contract for erecting the electric light plant has been awarded to the Edison Electric Light Company.

**Savannah, Ga.**—A franchise has been granted to the West End Railway Company to build and operate an electric railroad.

**Harrisonburg, Va.**—The new electric light plant is nearing completion. The streets of the city will be supplied with 50 more arc lights.

**Sherman, Tex.**—The city has received seventeen additional street lamps, which will make quite an improvement when placed in position.

**Cedartown, Ga.**—The city, at a recent election, voted to issue $50,000 worth of bonds for the erection of an electric light plant and the construction of water works.

**Flemingsburg, Ky.**—D. J. Hauss has organized the Flemingsburg Electric Light Company. The company will soon begin the erection of an electric light plant.

**Clifton Forge, Va.**—It is expected that the electric light will be ready to be turned on by the Fourth of July. The citizens can then celebrate the evening with the electric lights.

**Colorado City, Tex.**—The electric light company has been reorganized. The company will extend its service over the entire city. Mr. Isaac Gronskey is president of the company. The capital stock is $50,000.

**Atlanta, Ga.**—H. L. Woodward, J. H. Mountain and E. B. Woodward have chartered the Grant Park Electric Railway Company. The company will build an electric railroad. The capital stock is $100,000.

**Baltimore, Md.**—The North Avenue Electrical Railway Company has awarded to David E. Evans, of Baltimore, the contract for laying the track and overhead work on its new extension, which is soon to be built.

**Vicksburg, Miss.**—Proposals have been asked for by C. L. Spaulding of Washington, D. C., for manufacturing and placing in position in the United States Custom House here combination electric light and gas fixtures.

**Richmond, Va.**—Two dynamos of the Electric Light and Power Company's plant were recently burned out during a severe storm. This makes seven dynamos which this company has lost by lightning within a very short time.

**Leesburg, Fla.**—G. C. Stapylton is president, W. D. Taylor, vice-president, and B. R. Milam, secretary, of the Leesburg Electric Light and Water Power Company, which was recently incorporated in this city. The capital stock is $50,000.

**Galveston, Tex.**—The Secretary of the Treasury at Washington City has advertised for bids for manufacturing and placing in position combination electric light and gas fixtures in the United States Custom-House and Post-office at Galveston.

**Alexandria, Va.**—The National Electric Company, of Washington, D. C., with a capital stock of $1,000,000, was recently chartered here under the Virginia State laws. The officers are: P. Mason, president; W. J. Dante, secretary and treasurer.

**Chester, S. C.**—The president of the Southern Ice and Cold Storage Company, of this city, has made a proposition to the city that if it will pay one-half of the cost of construction he will erect an electric light plant and an ice factory. It is expected that this will meet with popular approval. V. N. B.

## ENGLISH NOTES.

*(From our own correspondent.)*

LONDON, June 17, 1891.

**City and South London Railway.**—The effect of the recent "bus" strike upon the receipts of this line has been to send them up to the highest weekly figure hitherto reached, namely, £860. At a meeting of the shareholders of the company held on Tuesday a consultation was held with the directors as to the best mode of raising £50,000 additional capital for laying down sidings for the accommodation of the extra traffic, and the additional plant and rolling stock demanded by the Board of Trade. The chairman stated that the authorized capital was £1,025,000, of which £800,000 had been expended, and he proposed, in view of the heavy depreciation of all railway stocks at present, to raise money by preference shares, and he asked for power to add £150,000 worth to the authorized share capital of the company, one-third of which only would be issued immediately. The result of the working of the line up to the present had showed, he said, that they might put the working expenses at £28,000 and annual income at £40,000. The traffic had considerably increased during the past few weeks, and there was every reason to believe that before long the railway would prove a good dividend-paying concern. They had already carried 3,000,000 persons in perfect safety. In the discussion which followed the shareholders expressed great satisfaction with the chairman's statement. The Greenwich observatory authorities, I may add, are complaining that they can time the companies' trains by means of their earth current apparatus; a curious illustration of the enormous distance to which currents apparently stray, since the end of the railway tunnel is more than two miles from the nearest earth plate connected with the observatory.

**The Chemistry of the Secondary Cell.**—In a couple of papers read recently before the Royal Society by a Mr. G. H. Robertson valuable light is thrown upon the complex chemistry of the secondary cell. The author points out with great truth that hitherto the chemistry of the *plates* has alone been studied, while that of the *electrolyte* has been neglected, although it is well known that the electrolysis of sulphuric acid presents several curious phenomena. Some years ago Frankland came to the conclusion that the lead sulphate formed during the normal discharge and reduced during the normal charge of a secondary battery could not be the white sulphate commonly known to chemists, because first of all it was not white, and secondly, because it was so easily reduced, common white sulphate being practically irreducible. Mr. Robertson shows that the color is entirely due to the fact that the $PbSO_4$ is intimately mixed with granules of $PbO_2$, and also that under these conditions it is well known to chemists that lead sulphate is easily reducible. The abnormally high E. M. F. of the secondary battery immediately after the completion of charging; the fact that a battery apparently completely run down, if left to itself, will recover, and after some time give a further discharge, and many other hitherto perplexing phenomena, are in a fair way of being explained by the discovery on the part of Mr. Robertson of the presence in the electrolyte in large quantities of hydrogen dioxide. At present it must be confessed that the elucidation of the various obscure points connected with the chemistry of the secondary cell has not brought us very much nearer to that desideratum, a cheap, durable, light and high discharge battery for traction purposes; but it would be entirely contrary to past experience if the continual increase in our knowledge does not give us some decided improvements in the practical construction of secondary batteries.

**Meeting of the Physical Society.**—At the meeting of the Physical Society on Friday last the leading points of a very interesting paper by Prof. Ayrton and Dr. Sumpner were briefly alluded to, the subject of the communication being "Alternate Current and Potential Difference Analogies in the Methods of Measuring Power." The analogies referred to were comparisons between numerous methods of measuring the power of alternate current circuits by means of voltmeters, ammeters and electrostatic instruments. The numerous methods devised by the authors, by Mr. Blakesley, by Dr. Fleming and by Mr. Swinburne and the electrometer methods of Blondlot and Currie, were classified and generalized, and the anology, *i. e.*, "the equivalent functions of various different but corresponding parts," was pointed out. Thus where the authors of the paper used voltmeters, Dr. Fleming uses ammeters; and the relative merits under different circumstances of different methods was touched upon. The paper which will probably be published in the *Philosophical Magazine* or the *Proceedings of the Physical Society*, will be a very interesting work of reference on this subject. Dr. Oliver Lodge showed two clocks for pointing the direction of the earth's motion in the ether, but explained how the direction of any point on the earth's surface at any moment is in the direction of the west as far as the diurnal rotation of the earth is concerned at the rate of 700 miles an hour, it is also in the direction at right angles to the sun in the plane of the ecliptic, by reason of its rapid motion at the rate of 19 miles per second, while the solar system generally is supposed to be moving toward the constellation of Hercules at the rate of five miles per second. The simplest and most intelligible form of the instrument was a clock with a spindle inclined to the polar axis, carrying a disc which revolved once in 24 hours. On this were marked the months of the year, and the instrument being set north and south, the direction of the radius corresponding to the date upon this disc points out the direction in which the instrument is moving through the ether. Dr. Lodge had been led to this by the consideration of problems connected with aberration. He then showed a very interesting and simple experiment with the sympathetic discharge of two Leyden jars, and exhibited the effect of a sudden wave of electric displacement on a long suspended wire, which, receiving the discharge of a Leyden jar of considerable dimensions, acted as a closed organ pipe, the length of the wire corresponding to one-fourth of a wave length. In a darkened room the wire, which was about 50 or 60 feet long, appeared to be surrounded by a luminous glow at the end of the room from the Leyden jar, and this glow died away and became invisible at about 20 or 30 feet from the jar. Dr. Lodge showed an extremely interesting receiver for Hertzian vibrations, which he termed an "artificial eye." This had been designed by his assistant, Mr. Robinson, and consisted of a glass plate covered with tinfoil and scratched to form a grating, the bars being divided by a number of transverse lines, these forming a large number of Hertzian resonators of varying dimensions.

## Answers to Correspondents.

*Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.*

**Electric Lights from Primary Cells.**—Can I obtain two electric lights from a primary battery? E. B.

You can, but the expense is considerable, and the results are unsatisfactory without expert attendance.

**Motors on Edison Circuits.**—In connecting a 220-volt motor in the Edison three-wire system does it make any difference which one of the outside wires is connected to binding post, from which both armature and field are connected? H. C. F.

No.

**An Electrical Engineer.**—Will you please inform me where I can see Sir William Thomson's address wherein he gives his views upon what are the most important points in the education which makes the electrical engineer? R. H. D.

See address given in full in THE ELECTRICAL WORLD of April 27, 1889.

**The New Unit "Henry."**—(1) Practically speaking, what is the "henry"? Is it an ohm-second? (2) What is the correct pronunciation of the word "hysteresis"? W. B. H.

(1) Practically speaking, the henry, which is the unit of self-induction, having the dimension of length is a term interchangeable with the "secohm"—an ohm-second—and the "earth quadrant." (2) Hisster-ee'-sis.

**Telephone Circuits.**—Will you kindly inform me through your correspondent column of the method of stringing and connecting up a copper return wire for telephones, to be used in place of a ground? W. C. B.

We would refer you to T. D. Lockwood's most excellent handbook upon the subject, "Practical Information for Telephonists," published by The W. J. Johnston Company, New York City.

**Lenz's Law.**—What is the rule for determining the direction of current flow in armature wires with given pole signs and a given direction of rotation? W. A. E.

We would refer you to a careful perusal of Lenz's law, which is to be found in most electrical textbooks. Briefly stated, Lenz's law is: "The direction of the currents set up by electromagnetic induction is always such as to oppose the motion producing them."

**Storage Cells.**—Will you please give me the details of the cells used in connection with the train-lighting plant described in THE ELECTRICAL WORLD of May 10, 1890? R. S.

The Accumulator Company, of 224 Chestnut street, Philadelphia, Pa., will very likely give you the information in full. Your letter is extremely vague where you reiterate our statements regarding the number of lamps run. Our correspondents should realize that in order to have their questions clearly answered they should express themselves explicitly.

**Incandescent Lights on Arc Circuits.**—I have a 35 arc-light dynamo, and as I use only 23 lights, I wish to run in connection therewith 12 incandescent lamps of 20 volts each. What arrangement is necessary in order to accomplish this? A. M. K.

Series-parallel lights are rather unsatisfactory unless placed by the company which installed your machine, and we believe that you will find series lamps which take the full current of nine ampères, and which do not require the insertion of a resistance in the line to give good results. The company from which you obtained the dynamo will probably supply these lamps.

**Measuring Motor Currents.**—I would be obliged if you would answer the following questions in your paper: (1) Why is it that experts claim it to be difficult accurately to measure a motor current? (2) Can it be measured by meter? (3) Which make is best for such a purpose? (4) Would there be any risk of damaging a 107-volt meter by placing it in a 500 volt circuit? (5) Is it probable that after long and continued use the proportion between the shunt and resistance coil of an Edison meter will change? S. F. A.

The current of a motor is measured by placing the ammeter in series with one of the leads in the ordinary way. In the case of an arc circuit motor a voltmeter must be placed across the terminals of the motor, and the watts consumed calculated from the reading obtained in connection with the current of the line. (2) Yes, a meter can be used. (3) Probably the meter supplied by the company making the motor (4) You would probably lose your meter. (5) Practically speaking, no appreciable change will take place.

# News of the Week.

## THE TELEGRAPH.

**The Commercial Cable Company** announces that it has just opened a new office at Newcastle-on-Tyne, England, with special wire service in connection with the ocean cable, so that messages handed to this company from this time on will be under its entire control.

## THE TELEPHONE.

**Government Control of Telephones.**—Justice Clarke, of Raleigh, N. C., in a letter to a local paper, gives his views upon the telephone question and strongly advocates government control for the telephone systems.

**Wheeling, W. Va.**—A telephone is to be constructed to the mouth of Williams River. The line will start from Sutton, W. Va., and will go to the tunnel, and from there it will be built to the river. It will follow the river to the mouth of Laurel Creek. Thence up Laurel Creek to the mouth of Williams River.

**A New Telephone Booth** for the use of long-distance lines is now offered to subscribers by F. S. Tainter, the Eastern agent at Cortlandt street, New York City. This booth has been found thoroughly soundproof, and is made in two separate parts—a complete inner booth having rubber contacts underneath, and an outside booth covering it, leaving an air space entirely around the inner one. The booths are portable and are readily put together or taken down. A large number of the most important long-distance telephone offices in the country are using them.

**The Yale-Harvard Race by Telephone.**—Through the enterprise of the Southern New England Telephone Company, of New Haven, Conn., the stay-at-home New Haven people were able to follow the Yale-Harvard boat race from beginning to end. Three wires were stretched from the telephone building in New Haven, Conn., one of which was flagged off to represent the course, the miles being designated alternately by red and blue flags. From the other two wires were suspended miniature shells, the crew of one being painted blue to represent Yale and the other red for Harvard. As the race progressed and the telephone reports were received, these shells were drawn along the wires and the relative positions of the crews were shown, giving a very good idea of the contest. At New London, Conn., five stations, each equipped with a long-distance transmitter, were placed one at the start and one opposite each of the mile flags. At the instant the word "go" was given by the referee at New London, it was telephoned to New Haven by the station at the start, and the miniature shells began their journey across the street, a cannon being fired from the top of the Telephone building to call attention to the fact. By this time the street was blocked and the crowd continually increasing. Meanwhile the Harvard shell was slowly creeping away from its rival in accordance with the reports received from New London, and by the time the first mile flag was reached it was fully three lengths ahead; at the same time a large bulletin was displayed in the window, giving the time of both crews to that point, their strokes per minute, and the shape they were rowing in. When either of the crews spurted the shells gave evidence of the fact, and the crowd hardly breathed until the suspense was over. After the race was over the crowd quietly dispersed, all giving praise to Superintendent E. B. Baker for representing the race, and trying to offer some excuse for Yale's defeat.

## THE ELECTRIC LIGHT.

**Oil City, Pa.**—The electric lighting plant is to be completed this week.

**Seattle, Wash.**—The electric light franchise has been granted to Mr. Charles H. Barker.

**Irwin, Pa.**—The contract for the electric light plant has been let to the Thomson-Houston company.

**Rochester, N. Y.**—The State Industrial School will receive proposals for electric lighting until July 1.

**Georgetown, Tex.**—The erection of an electric light plant is projected. Mr. John Steele can give information.

**Watkins, N. Y.**—The electric light company has been granted an extension of time until August to light the town.

**Paris, Tex.**—The Paris Gas and Electric Light Company has a contract to erect the electric light plant reported recently.

**Hallettsville, Tex.,** is to begin work upon its electric light plant at last. There has been considerable delay in getting the proposition considered properly.

**Gettysburg, Pa.,** is to pay $1.800 a year for 17 arc and 16 incandescent lights. The cost of lighting the streets last year, including supplies and salaries, was $1,013.30.

**Millville, N. J.**—The street lighting contract has been given to Mr. Walter Wood, of Philadelphia, Pa. Mr. Wood's bid was for a three-year contract, at $65 per annum per light for arc and $25 for incandescent lights.

**Ford City, Pa.**—The Pittsburgh Plate Glass Works has awarded a large contract to the Edison Company for installing a large isolated arc and incandescent lighting plant for its enormous factory. An electric tramway is also to be installed.

**Seymour, Ind.**—Mr. Wm. H. Shields has been granted a franchise for an electric light company. The contract of the old company for lighting the city holds three years longer. The object of the new company will be to furnish private and business houses.

**Pulaski, Tenn.**—Mayor M. C. Comody, Recorder James T. Oakes, J. W. Dwyer, Theo. Richardson and Frank Webb have been sent to Nashville by the Municipal Council to investigate its system of electric lighting with a view to establishing a plant in this city. Gas is found to be too expensive and unsatisfactory.

**Le Mars, Ia.**—The city council has granted Mr. J. U. Winchell a franchise for an electric lighting plant, subject to the approval of the citizens by ballot. The plant to be completed about September. About one hundred and twenty 32 c. p. incandescent lights and

ten 1,200 c. p. arc lights will be used. The arc lights are to run all night. As yet no particular system has been decided upon.

**Pittsburgh, Pa.**—The East End Electric Light Company has sent out to its customers the following notice: "On and after July 1 no more lamps will be replaced free of charge. A charge of 70 cents for every 16 candle power lamp will be made. Prices for new globes will range from 70 cents for 16 candle power to $1.75 for higher candle power. A rebate of 10 cents will be allowed on the return of old globes."

**Frankford and Tacony, Pa.,** suburbs of Philadelphia, were thrown into semi-darkness last week by the bursting of one of the steam pipes at the Suburban Electric Light Company's works, at Tacony. After the defect was remedied the storm burst in all its fury on that portion of the city, but without causing any visible damage, though much injury from lightning was experienced by neighboring towns.

**Mr. Gordon,** who was formerly connected with the McKeesport Light Company, of McKeesport, Pa., and has for some time been in the employ of the Westinghouse Electric and Manufacturing Company, selling electrical apparatus in the State of Texas, was a visitor to Pittsburgh, Pa., last week. Mr. Gordon reports that while electricity has been pretty generally introduced in the big Lone Star State, there is still room for considerable business, both in the lighting and power line.

**Franklin, Ind.**—The City Council has accepted the franchise of the Franklin Water Company for lighting the city. The plant is to consist of 30 arc and 10 incandescent lamps. The prices are: $75 for midnight and $90 for all-night lighting, with a third option given the city that four months in the year all-night lights be discontinued at midnight, and to be relighted from four o'clock to daylight at $85 per lamp. The cost will thus be $75.33 per lamp, a saving of $150 a year over the present cost of gas lighting.

**Kentucky Sales.**—Mr. Thomas H. Fearey, manager of the Louisville office of the central Thomson Houston Electric Company, has recently made the following sales of lighting apparatus: Versailles, Ky., 30 arc lights and 650 alternating incandescent lights; U. S. Engineering Corps, Lock No. 6, Kentucky River, four arc lights; Lexington, Ky., 50 arc lights and 1,300 alternating incandescent lights; Catlettsburg, Ky., 50 arc lights and 650 alternating incandescent lights; Louisville, Ky. (Northwestern Ice Company), 150 incandescent lights; and at Lexington, Ky. (Electric and Belt Railroad Company), eight single reduction gear motors and car equipments.

## THE ELECTRIC RAILWAY.

**Newton, Mass.,** is still fighting for the electric street railway. Much difficulty is met with in regard to the necessity of the line's crossing the Boston & Albany Railroad.

**Pittsburgh, Pa.**—The Pittsburgh Plate Glass Works has awarded a contract for an electric tramway for its works at Ford City, Pa., to the Edison General Electric Company. The factory is also to have a large arc-lighting plant

**Mr. Th. Gonet,** one of the engineers connected with the railway department of the Westinghouse Electric and Manufacturing Company, departed a few days ago for Los Angeles, Cal., whither he went to have charge of the starting of the equipment of the Los Angeles Street Railway Company.

**Dr. V. T. McGillicuddy,** of Rapid City, S. Dak., is in the market for a storage battery car. Rapid City is too small to support an extensive system of rapid transit, but a single electric motor car, the current for which could be supplied from a set of storage cells, would probably prove a profitable investment, as the electric light company has ample water power at its disposal.

**Baltimore, Md.**—An order for the poles and wire for the line construction of the North Avenue Electric Railway has been given to David E. Evans, Esq., agent for the Brush Electric Company, at Baltimore. He has also been awarded the contract for tracklaying. The other part of the work on the line and the supplying of the cars and motors will be done by the Baxter Motor Company.

**The Morris Trolley Hangers,** which are being manufactured in large lots by Mr. George Cutter, of Chicago, Ill., have the advantage of giving a double insulation, and Mr. Cutter has received numerous favorable comments upon the Morris hangers. They are all fitted with the strong and simple clamp ear which experienced railway men have found to be one of the best. Mr. Cutter's lamp-supporting pulley has many good points about it, and is bound to sell of itself. It is thoroughly sleet-proof, and will hold the lamp securely even if the hoisting rope should slip, so that it will save the cost of many a lamp in the course of a year. This pulley infringes no patent, and it is claimed Mr. Cutter announces he will protect users against any threatened suits.

## LEGAL NOTES.

**Patent Infringement Suit.**—A suit has been commenced by Mr. George Maitland, owner of what are claimed to be the controlling patents on electric and combination gas and electric fixtures, through his counsel, Messrs. Philipp, Munson, Phelps & Hovey, of this city, in the United States Circuit Court at Philadelphia, against Alfred C. Gibson, doing business in connection with The Gibson Gas Fixture Works, of Philadelphia, Pa., who has appeared through his counsel, Theodore F. Jenkins.

**Massachusetts vs. Western Union.**—The Western Union Telegraph Company is the defendant in an action that has just been commenced in the Supreme Judicial Court by the State of Massachusetts. The suit is brought on account of the non-payment of taxes. The Western Union's unpaid taxes amount to $17,713. Notice was served on the company in accordance with the law, which requires this formality, and also requires that the delinquent corporation must settle some time within 30 days afterward, but the Western Union Company allowed this time limit to pass by.

**Right of Massachusetts Towns to Maintain Electric Light Plants.**—The legislature of Massachusetts can, by statute, confer upon towns authority to construct and maintain works for the manufacture and distribution of electricity to be used by the towns and the inhabitants for illuminating purposes; but such authority is not within any of the customary powers which towns, from very early times, have exercised, and must be derived, if it exists, from the statutes relating to towns. The mere authority to maintain street lamps does not imply the power to erect plants for the manufacture of the light, any more than a public library confers upon a municipality the right to operate a paper mill and publishing establishment. The right to purchase and operate an electric plant must be specifically conferred, and the Massachusetts statutes do not contain such a grant. (Spaulding v. Peabody, Supreme Judicial Court of Massachusetts.)

## MISCELLANEOUS NOTE.

**Fishing by Electricity.**—Mr. W. G. Rifenburg, a few years ago proprietor of the United States Hotel at Trinidad, Cal., and at present making his home at San Diego, Cal., may yet prove to be the Edison of the Pacific coast. He has invented a plan by which fishing is done with incandescent lights and a net. Everything alive under the water is attracted by the glare of the light and thousands of fish of every description can be taken in a short time and with little trouble. A sloop recently left San Diego on a novel fishing trip, accompanied by Mr. Rifenburg, the inventor of the apparatus. An electric plant is on board and the party will be gone two or three months. The practical result of the first voyage will be watched with much interest in San Diego, and if it is as successful in deep water as the experiments in the bay have been the projectors of the enterprise are confident they will have solved the problem of supplying all southern California with cheap fish.

## EDUCATIONAL NOTES.

**Harvard Electric Club.**—At the annual meeting of this club the election of officers resulted as follows: President, G. S. Curtis; vice-presidents, C. H. Arnold and P. L. Spaulding; secretary, T. Hoppin; treasurer, H. C. Smith; librarian, P. W. Davis. G. T. Page, C. H. Arnold and H. Gregory compose the Executive Committee.

**Electrical Instruction in the South.**—The electrical department of the Agricultural and Mechanical College of Alabama, at Auburn, will be opened next fall. This college is probably the leading mechanical institution in the South, and has naturally a fine location, being, as it is, in the iron region of Birmingham, Bessemer, Florence and Decatur. Mr. A. F. McKissick has been chosen to take charge of the electrical department, and will at once set about its organization.

## PERSONALS.

**Mrs. Hannah T. Farmer,** wife of Moses G. Farmer, died at Eliot, Me., on Saturday of last week.

**James Huntington, Esq.,** president of the James Huntington Machine Company, of North Adams, Mass., died last week at his home in North Adams.

**Mr. Alfred Kornfeld,** of THE ELECTRICAL WORLD office, was married on Sunday of last week to Miss Henrietta Eisenberg, of New York.

**Mr. Theodore Larbig,** well known to the electrical fraternity through his connection with the firm of Holmes, Booth & Haydens, and more recently with the Aluminium Brass and Bronze Company and the Phillips Insulated Wire Company, of Pawtucket, R. I., was shot and killed on Saturday night of last week while engaged in an unfortunate quarrel with a resident of Brooklyn. Mr. Larbig had just returned from one of his business trips and was spending a few days in New York City.

## Industrial and Trade Notes.

**The Electrical Supply Company,** of Chicago, is the Western agent for the Stanley alternating current fan motors, recently illustrated and described in our columns, and has issued a pamphlet describing in detail the principal features of this new type of fan motor.

**The Wolfe Electrical Company,** of 1,614 Capital avenue, Omaha, Neb., has added to its already large stock of general electrical supplies a full line of Bunnell's celebrated telegraph instruments, which are meeting with ready sale. A complete line of electric light specialties is also carried.

**The Hart & Hegeman Manufacturing Company,** formerly of Kansas City, Mo., have removed to 190 Pearl street, Hartford, Conn., where they have greatly increased facilities. The company will manufacture, in addition to the celebrated "Hart" snap switches, a line of electric lighting specialties of new and novel designs, a full exhibit of which will be shown at the Montreal Convention.

**Mr. C. N. Souther,** the city ticket agent of the Chicago, Milwaukee & St. Paul Railroad, 207 Clark street, Chicago, is about to place a new form of blue vitriol battery on the market, especially designed for use in telegraphic service. From the extended tests of the new cell carried on for several months such excellent reports have been received as to warrant Mr. Souther in preparing to supply the same to the trade.

**Mr. C. E. Sargent,** manager of the Chicago office of Messrs. A. L. Ide & Son, has sold since the first of the year 28 Ideal engines aggregating 3,000 h. p. Sixteen of these engines were for Chicago plants. The largest order was for five 250 h. p. engines for the Citizens' Street Railway Company, at Memphis, Tenn. Messrs. Ide have 84 engines running electric plants in Chicago, which speaks well for their engine.

**The New Process Rawhide Company,** of Syracuse, N. Y., has received the following commendatory letter from Mr. T. L. Poole, secretary of the Syracuse Consolidated Street Railway Company: "After several months' use of your pinions upon our electric cars we are so well satisfied that we have concluded to use them on all our cars now building. We recommend them to all companies who desire to secure economy, durability and comfort."

**The Great Western Electric Supply Company,** of Chicago, has profitably leased to a wholesale clothing house the double building, 190 and 192 Fifth avenue, which it has occupied for more than a year past, and will move into less expensive and more convenient quarters. The company has transferred its manufacturing department into the Springer building on Canal street, where it has ample facilities for turning out any quantity of goods.

**Mr. Thomas Pray, Jr.,** well known as a consulting engineer, has recently opened an office in the Times Building, New York City, and is now giving his time to the making of various tests called for in the use of steam and electricity in plants for lighting, railway work and various other applications in which the combination is used. Mr. Pray's specialty is the steam engine indicator, and he makes both steam and electrical measurements. His address is 193 Times Building.

**The Colburn Electric Manufacturing Company,** of Fitchburg, Mass., well known as the manufacturer of dynamo machines for electric lighting and electroplating, and of motors for constant potential circuits, has issued a very handsomely printed advance sheet, showing illustrations of nine of its latest types of machines, and giving some mechanical and electrical data of the company's lighting and depositing dynamos and motors. A catalogue will soon be issued containing much other information.

**The Eclipse Span-Wire Holder,** made by Mr. D. C. Giles of Elmira, N. Y., for electric railway uses, consists of a frame made of a good quality of soft iron carrying a large drum, and a dog or wedge which permits of any amount of forward or tightening movement of the drum, but clamps so firmly as to prevent any backward movement of it. The frame is strong and heavy, and nearly all the metal is placed directly in the line of pull. For attachment to the street railway pole a ⅝-inch pole is provided, either 6, 8, or 10 inches long, as desired.

**The Clark Electric Company,** of 192 Broadway, New York City, which controls the well-known Clark system of arc lighting, has met with great success in the installing of a large number of plants, which have in every case given the best of satisfaction. The Clark system comprises many novel features in the line of safety devices and regulating apparatus, among which might be mentioned the company's automatic safety device. This latter ingenious piece of apparatus has been found of most practical service in preventing accident from broken line wires.

**The Page Belting Company,** of Concord, N. H., has opened a branch house at 165 Lake street, Chicago, where it will carry a full and complete stock of leather belting, the Acme link belting and belting supplies of every description. There is now in stock double leather belting ranging in width up to 32 inches, thus insuring prompt shipments of ordinary orders. Mr. F. F. Wormer is the gentleman in charge, and he has recently shipped or received orders for eight 20-inch and four 15-inch belts for driving Edison dynamos; two 20-inch, one 18-inch and one 24-inch Acme link belt for street railway generator work.

**The Sperry Electric Mining Machine Company,** of Chicago, has issued a circular calling attention to the merits of the "Sperry" special snap switch for incandescent circuits, and state therein: "The '4 S' to ampère switch measures less than three inches over all, and has but two working parts. It is operated by a thumb piece which unscrews when turned backward, and its action is easy and positive. The wide, double break which combined measures more than one and three-quarters inches will break several times the voltage in ordinary use, thus insuring long life to the switch. The motion of the bar passing over the flexible bronze brushes always keeps the contact surfaces clean and bright."

**The "C. & C." Electric Motor Company,** of New York City, has been doing a rushing business with its excellent fan motors of late. A number of large ventilating fans with C. & C. motors connected directly to the fan shafts have been running for several months past in the Pennsylvania State Capitol building at Harrisburg, one in the Assembly and one in the Senate chamber. The members have been most enthusiastic over the success of these machines, and have passed resolutions testifying to the great improvement the outfits have effected in the atmosphere of the room. Several handsomely finished fan motors have also been installed recently in the White House at Washington, D. C. The White Star steamship City of New York has been equipped with C. & C. fan outfits with 18-inch fans. The Edison Electric Illuminating Company, of New York, bought 100 C. & C. fan outfits last week, and the new operating room in the City Hospital, Rochester, N. Y., is ventilated by a C. & C. exhaust electric fan combination, with a fan 36 inches in diameter.

**The Sioux City (Ia.) Engine Works** has issued a circular calling attention to the large number of its engines now in use by electric light and street railway companies, notably by James Bell, Corliss 22x24, David City, Neb.; Chillicothe Water, Gas and Electric Light Company, high speed 10x16, Chillicothe, Mo.; E. A. Odione, Corliss 14x24, Yankton, S. Dak.; Pasadena Electric Light Company, Corliss 14x36, Pasadena, Cal.; Des Moines Electric Railway Company, Corliss 20x42, Des Moines, Ia.; Wyatt Electric Railway, Corliss 18x36, St. Joseph, Mo.; Winterset Electric Company, high speed 13x20, Winterset, Ia.; Blair Electric Light Company, high speed 10x16, Blair, Neb.; Missouri Valley Electric Light Company, Corliss 14x36, Missouri Valley, Ia.; Lindsay Bros., Corliss 12x24, Pasadena, Cal.; Storm Lake Electric Light Company, Corliss 12x24, Storm Lake, Ia.; Beatrice Electric Light Company, Corliss 14x36, Beatrice, Neb.; City of Stuart, high speed 13x20; Beloit Light and Water Company, high speed 10x16, Beloit, Kan.; Geo. B. Johnson, Corliss 14x36, Hastings, Neb.; Wm. Cramer, high speed 9x14, Sioux City, Ia.; N. Lincoln Street Railway Company, high speed 14x36, Lincoln, Neb., and City of Afton, Ia., high speed 8x12. All of the above are electric light plants.

**The Electrical Forging Company,** with general offices at 194 Washington street, Boston, Mass., is a company recently incorporated, with a capital stock of two millions, to exploit the patents of Mr. George D. Burton enumerated below. The officers of the company are George D. Burton, president; Chester Marr treasurer; Fred J. Hutchinson, secretary. The directors are J. C. Moore, E. Spalding, C. E. Dresser, G. D. Burton, M. V. Livingston, F. J. Hutchinson and C. F. Adams. This company is the owner of the following patents issued to G. D. Burton, which, it is claimed, broadly cover the method of making forgings by electricity: No. 427,151, method of and apparatus for making forgings by electricity; 435,110 and 435,111, for electrical forging machines, and electric bar heating and feeding apparatus for forging machines; also patents for methods of and apparatus for working metals by electricity, and electric blank heating and feeding apparatus for forging machines. In its prospectus the company says in regard to its process of forging: "In the electrical forging machine the metal is softened to the proper degree by a current of electricity; it is then fed to the forging dies by the automatic action of the machine, which gives to the softened piece the desired shape. The current of electricity is regulated by automatic devices so as to give the required degree of heat to bars or rods of metal that are of different dimensions. A small bar of metal may be worked, and the dies then changed, if necessary, for those capable of working articles from a bar of greater size, the heating of which is accomplished by increasing the volume of the current. An important advantage is possessed by this method, inasmuch as every piece is heated alike, and is forged or shaped while in the same softened condition. When articles require tempering in order to make them marketable as well as serviceable, it will be seen by this process that each piece having been heated to the same degree (unless the current of electricity is changed), is better adapted to receive the proper hardness or softness as required, from the fact that each piece formed by the dies is heated to the same temperature before it comes in contact with the dies. Another advantage of this machine is shown in the saving of time required in the heating of the metal as compared with the old method of heating in a forge. To illustrate, a piece of metal that requires, say, twelve minutes to prepare in the forge is heated and shaped by this machine in less than forty seconds, and at much less cost. The product of this machine is firmer and better, and will withstand the wear longer than articles made by the old method."

# OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

## U. S. PATENTS ISSUED JUNE 23, 1891.

**454,462. Electric Elevator;** Rudolf Eickemeyer, of Yonkers, N. Y. Application filed May 14, 1890. In elevator machinery the combination, with the traveling car or platform, of an electric motor adapted to both hoist and lower the car, a movable switching device adapted, according to its position, to open and close the motor circuit and admit current in respectively opposite directions through the armature-circuit, and mechanical means accessible to an attendant on the car or platform for controlling the position of said movable switching device.

**454,475. Electric Regulator for Constant Potential;** Carl Hering, of Philadelphia, Pa., Assignor of one-half to John Hoskin, of same place. Application filed Dec. 16, 1887. A regulator for maintaining constant the potential of a shunt-wound dynamo, a direct-acting electromagnetic device whose current is derived from the points at which the potential is to be kept constant, and an adjustable resistance in series with the shunt magnet coils, which is increased by greater current in the electromagnetic device and decreased by smaller current in the electromagnetic device,

NO. 454,486.—OVERHEAD ELECTRIC SYSTEM.

said resistance being a carbon pile consisting of plates or discs of carbon, the axis of which pile is inclined between the horizontal and the perpendicular.

**454,476. Electric Regulator for Constant Potential;** Carl Hering, of Philadelphia, Pa., Assignor of one-half to John Hoskin, of same place. Application filed May 24, 1889. In combination with an electric regulator for constant potential, having an electromagnet and having a resistance adapted to be diminished in conductivity by increase of current through its electromagnet, a relay having an electromagnet and having a resistance adapted to be increased in conductivity by increase of current through its electromagnet, said first named electromagnet and last-named resistance being in the same circuit. (See illustration.)

**454,485. Electric Arc Lamp;** Hermann Lemp and Merle J. Wightman, of Hartford, Conn., Assignors to the Schuyler Electric Company, of Connecticut. Application filed Oct 26, 1886. An electric arc lamp, having a lever or support carrying the feed-controlling mechanism that engages with the carbon or carbon carrier, a frame or support in which the lever is pivoted, a main-circuit magnet for lifting or operating the frame, so as to form the arc, and detent devices for said controlling mechanism, having parts arranged to release the mechanism when the lever is moved by the controlling magnet on an increase in the normal length of arc and when it is moved in a reverse direction to an abnormal extent when the lamp goes out of action.

**454,486. Overhead Electric System;** Charles A. Lieb, of New York. Application filed Nov. 6, 1890. An insulating turnbuckle for electric wires, having a body part made of a single piece of insulating material recessed from the ends inwardly and threaded metallic endpieces. (See illustration.)

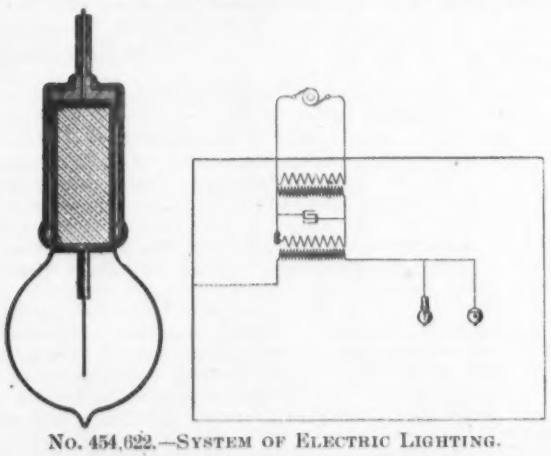
**454,487. Carhouse Hanger;** Charles A. Lieb, of New York. Application filed Nov. 18, 1890. A hanger comprising a base plate provided with means whereby it may be fastened to a wall or beam, and a counterpart plate, each having recesses which conform substantially to the hanger bar, bolts to draw them together and means at the end of the hanger bar for attaching the electric wires and said hanger bar.

**454,488. Commutator for Dynamos or Motors;** Charles A. Lieb, of New York. Application filed Dec. 12, 1890. A commutator brush having a fixed frame, and a series of contact points placed in holes therein diagonally across the commutator bars, and pressed against the commutator bars by separate springs which press upon but are independent of the contact points.

**454,496. Limit Switch;** Frank B. Rae, of Detroit, Mich., Assignor to the Detroit Electrical Works, of same place. Application filed Jan. 14, 1890. In a limit switch a circuit breaker normally held within the field of force of a magnet the poles of which are included in the circuit.

**454,503. Signal Attachment for Telephones;** Alfred D. Sundeen, Swan B. Molander and Gustaf W. Anderson, of Mora, and Andrew M. Carlsen, of St. Paul, Minn. Application filed June 23, 1890. In a return signal for telephones the combination of a train of gear wheels, operated by a winding spring and regulated by a rotary fan stopped and started by an electromagnet, with a roller provided with pegs and hammers operated thereby upon two bells, said bells being of different sounds, said pegs being so arranged that the one hammer will strike blows for the hours and fraction of hours of a clock, and the other hammer will strike one blow for Sunday, two for Monday, three for Tuesday, and so on until it strikes seven blows for Saturday, and means for setting the hammers at any desired day or hour, and means for connecting the action of the electromagnet with the said striking mechanisms, and means for conducting the sounds of the bells to the transmitter of the telephone, and means for indicating at the outside of the instrument how the inside of it is set.

**454,504. Signal Attachment for Telephones;** Alfred D. Sundeen, Swan B. Molander and Gustaf W. Anderson, of Mora and Andrew M. Carlsen, of St. Paul, Minn. Application filed June 23, 1890. The combination, with a telephone, of a phonograph and an electromagnet connected in the circuit of the telephone



NO. 454,622.—SYSTEM OF ELECTRIC LIGHTING.

for releasing the phonograph by passing an electric current over the line from other stations; means for conducting the sound of the predetermined speech from the phonograph to the transmitter of the telephone to which the phonograph is attached, and means for stopping the phonograph after it has given the distant station the predetermined information.

**454,522. Trolley-Pole Mechanism;** Geo. H. Larkin and James Tomkins, of St. Paul, Minn. Application filed Feb. 17, 1891. In a trolley-pole mechanism a stationery base frame upon the deck of the car and having a flat upper surface, a trolley-pole base frame and with bearing wheels in its outer end, the trolley pole having the trolley wheel and pivoted by its lower end in said trolley-pole base frame contiguous to its pivotal point, and springs connecting said trolley pole and trolley-pole base frame.

**454,532. Trolley for Railway Cars;** Edmond Verstraete, of St. Louis, Mo., Assignor of one-half to Peter M. Kling, of same place. Application filed July 26, 1890. In a trolley the combination of an arm, a cylinder, a piston fitting within the cylinder, and a connection between the piston rod and the arm.

**454,536. Electric-Car Trolley;** William Duncan, of Allegheny, Pa. Application filed Jan. 25, 1890. The combination, with a trolley pole, of the upright spring arms arranged on one side of the pole, and a supporting roller carried by said spring arms and adapted to contact with the trolley pole.

**454,541. Speed Regulator for Dynamo-Electric Machines;** Erastus E. Winkley, of Lynn, Mass. A rod or bar connected at one extremity with an eccentric which is revolved by original motor, said connection being similar to that in use in common valve regulators. The other extremity of the rod is revolubly connected with the link at or near its upper extremity, the link being revolubly attached at or near its lower extremity to some permanent point; another rod is revolubly connected with the link and adapted to be moved up or down in the same. This rod connects with the valve of the original motor.

**454,546. Electric Conductor;** Alfred W. Sperry, of Hartford, Conn., Assignor to himself and G. Wells Root, of same place. Application filed Oct. 27, 1890. Metallic electric conductors, having tubular ends and plugs to unite one length to the next, and a fire and water proof covering around the metallic conductors.

**454,555. Magnetic Separator for Paper Pulp;** Chas. H. Atkins, of Palmer, Mass. Application filed Aug. 11, 1890. A magnetic separator for paper pulp, having a conveying trough and magnetized bars within the trough, and resting upon and extending across the bottom of the same from side to side and constituting riffle-like obstructions, against and over which the pulp flows.

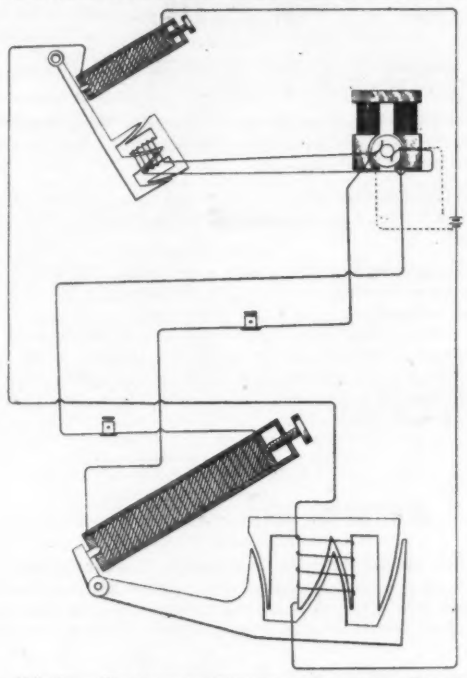
**454,558. Incandescent Electric Lamp;** Thos. A. Edison, of Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York. Application filed Aug. 7, 1882. An incandescent electric lamp, having an inclosing globe, a continuous integral loop-shaped carbon filament therein, conducting wires attached to the ends of said filament and extending outside the globe for electrical connection with an external circuit, and a third conducting wire connected with the middle point of the filamentary loop and also extending outside the globe for electrical connection.

**454,573. Electrical Pessary;** Walter N. Sherman, of Merced, Cal. Application filed Feb. 18, 1891. A pessary consisting of a disc or diaphragm of soft rubber formed with stiffening ribs and centre and provided with an electric generator.

**454,584. Switchboard for Telegraph Lines;** Frank T. Viles, of Hyde Park, and Nicholas Young, of Boston, Mass. Application filed Jan. 13, 1891. A detachable switch-hook for a switchboard, consisting of an insulated handle, two bars of uniform length extending therefrom and adapted to straddle a wire of one set, both of said bars being provided with springs and with hooks at their outer ends adapted to engage a wire of the other set.

**454,598. Galvanic Battery;** Philip Hathaway, of New York. Application filed Sept. 18, 1890. A chloride of silver battery, having a zinc vessel containing the negative element and the exciting medium, and also forming the positive element, with a negative element composed of chloride of silver cast in the form of a rod having an indented or corrugated surface.

**454,601. Electric Search-Light;** Gaston Sautter, of Paris, France, Assignor to Sautter, Harle & Co., of same place. A search-light mounted to move in altitude and azimuth and provided with



NO. 454,476.—ELECTRIC REGULATOR FOR CONSTANT POTENTIAL.

two motors in the base thereof, and intermediate mechanism whereby said light is moved in each of said directions by one of said motors, in combination with a controlling-switch for each motor, having an operating handle, and comprising movable and opposing contacts relatively arranged and connected with said handle, so that the motor stops when the said handle is in a middle position and turns in one direction or the other as said handle is shifted to one side or the other of said middle position.

**454,622. System of Electric Lighting;** Nikola Tesla, of New York. Application filed April 25, 1891. The method of producing an electric current for practical application, such as for electric lighting, which consists in generating or producing a current of enormous frequency, and inducing by such current in a working circuit, or that to which the lighting devices are connected, a current of corresponding frequency and excessively high potential. (See illustration.)

**454,625. Electric Signal for Railway Trains;** Francis P. Lenahan, of Wilkesbarre, Assignor of one-third to Paul A. Oliver, of Oliver's Mills, Pa. Application filed Feb. 28, 1891. The combination, with a pair of insulated conducting wires supported parallel with each other and with a railway track and crossing each other at intervals, of a bell and a battery on each train passing over the track, said bell and battery being in circuit with the pair of crossed wires, whereby the bells may be rung simultaneously as the trains approach each other irrespective of the direction of approach.

**454,626. Electric Motor;** Frank B. Rae, of Detroit, Mich., Assignor to the Detroit Electrical Works, of same place. Application filed Sept. 5, 1890. The combination, with a spring-actuated break-switch in the main line, the switch being provided with extensions, of a shunt field-magnet circuit including in series therewith the coils of an electromagnet, a pivoted spring actuated switch arm in the armature circuit, a series of resistances in said circuit, and a spring-actuated locking lever for the arm controlled by the said electromagnet in the shunt field circuit, the arm being provided with an insulated extension arranged to engage the extensions on the break-switch to operate the latter.

**454,627. Electric Motor;** Alexander B. Roney, of Chicago, Ill. Application filed Jan. 3, 1891. An electric motor having with the main shaft two or more radial arms, each provided with an auxiliary motor connected therewith, said auxiliary motors being provided with wheels adapted to travel about the face of the main field magnet, and being adjustable outwardly and inwardly upon said radial arms.

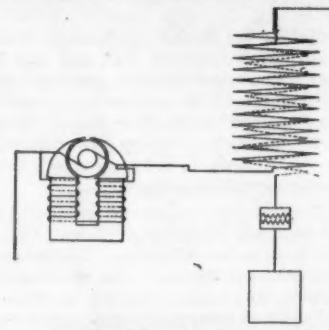
**454,630. Telegraphy;** Benjamin B. Toye, of Toronto, Canada. Application filed Sept. 25, 1890. In a main line circuit, one pole changer arranged to reverse the currents in the usual way, in combination with one continuity preserving transmitter and one break-before-make transmitter arranged to send currents of different intensities in the same direction.

**454,643. Electric Signal-Receiving Instrument;** Geo. L. Foote, of Brooklyn, N. Y., and Wm. C. Moore, of Kansas City, Mo., Assignors to the Electric Secret Service Company, of New York. Application filed April 14, 1891. A signal-receiver having a single electromagnet, a source for storing up energy, a circuit-closing device controlled in its advance movement by the armature of the electromagnet, and mechanical connections between said armature and the source for storing energy, whereby the circuit-closing device is positively moved in a reverse direction, and energy stored up for impelling it in its opposite direction.

**454,650. Regulating Electric Lights and Power;** Isaac Herzberg and Abram Herzberg, of Philadelphia, Pa. Application filed Dec. 10, 1890. A controlling device for electric circuits comprising an adjustable dial mechanism for rotating said dial, an electric switch, and a staff having two arms projecting therefrom, one of said arms being connected to the switch, and the other being controlled by the dial.

**454,669. Electric Hose Coupling;** Joseph B. Strauss, of Cincinnati, Ohio. Application filed March 19, 1891. In an electric hose coupling, an inner conducting part, an outer conducting part, a non-conducting medium secured between them, and a tube inclosing a pair of insulated wires, one of which communicates with said inner part and the other wire communicates with said outer part.

**454,671. Lightning Arrester;** Elihu Thomson, of Swampscott, Mass. Application filed Oct. 30, 1890. The invention comprises an electric line circuit, including an apparatus to be protected, a lightning discharge path from the line circuit, shunting such apparatus, and electro-responsive means respectively in such line circuit and shunt and arranged in inductive relation to one



NO. 454,671.—LIGHTNING ARRESTER.

another, so that the passage of the discharge through the shunt means generates a counter-electromotive force in the line circuit, opposing the passage of the discharge through the aforesaid apparatus to be protected. (See illustration.)

**454,672. Lightning Arrester;** Elihu Thomson, of Lynn, Mass. Application filed Nov. 5, 1890. A lightning arrester comprising a pair of discharge plates, a number of sets of polarizing cells in series therewith, and a plurality of discharge plates with jumping spaces in shunt with the sets of polarizing cells.

**454,673. Lightning Arrester;** Elihu Thomson, of Swampscott, Mass. Application filed Jan. 31, 1891. The invention comprises an electric line circuit including an apparatus to be protected, a discharge circuit shunting such apparatus, and including discharging and arc-rupturing devices and inductive devices, respectively, in the line circuit and shunt and arranged in inductive relation to one another, so that the passage of a discharge in the shunt-circuit induces in the line circuit a counter-electromotive force opposing the passage of the discharge through the apparatus to be protected.

**454,698. Method and Apparatus for Heating Bars by Electricity;** Edwin E. Angell of Somerville, Mass., Assignor to the Electrical Forging Co., of Maine. Application filed March 16, 1891. The invention consists in the method of heating metallic bars or blanks by inserting a bar or blank in an electric circuit, then inserting another bar or blank parallel in the same circuit side by side with the first blank, and then withdrawing one of said bars or blanks from said circuit during such withdrawal.

**454,717. Insulator for Marine Condensers;** Peter Decker, of Norwalk, Conn. Application filed Feb. 5, 1891. The combination with an exhaust-pipe of a steam engine in a sea-going vessel and a tube-condenser therefor which is exposed to sea-water, of a non-electric joint placed between these parts.

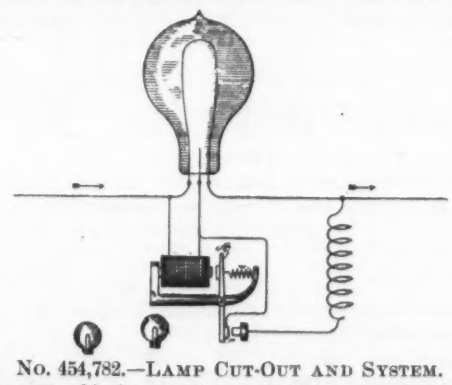
**454,724. Galvanic Battery;** Julius Emmner, Jr., of Washington, D. C., Assignor, by direct and mesne assignments, to Philip T. Dodge, Trustee, of same place. Application filed Dec. 15, 1890. This invention consists in constructing the carbon element in a series of horizontal plates or sections adapted to encircle the porous cup, and connected firmly with each other, their horizontal surfaces being separated to permit the free circulation of the exciting fluid between them.

**454,746. Electrical Fire-Alarm;** Brunswick W. Leonard, of Saybrooke, Assignor of one-half to John C. Nichols, of New London, Conn. Application filed March 24, 1891. In an electric fire-alarm, the combination of the general-alarm circuit, a circuit-closer placed in the said circuit, consisting of a base, a casing attached to the base, spring-contacts, a plunger, a catch carried by the said casing, an arm attached to the outer end of the plunger, an armature attached to the free end of the said arm, and means for operating the said plunger, consisting of thermal circuit-closers, a solenoid and local circuits connecting the thermal circuit-closers with the solenoid.

**454,782. Lamp Cut-Out and System;** Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Co., of Connecticut. Application filed March 20, 1886. An incandescent electric lamp, provided with a normally idle wire extending between the sides of the looped filament, in combination with cut-out devices operated by the passage of an abnormal current in said idle wire. (See illustration.)

**454,794. Electric Connection;** John B. Bickford, of Salem, Mass., Assignor to Joseph F. Porter, of New York. Application filed March 6, 1891. A bond or electric connection for railway rails composed of two terminals with holes through them, concentric annular projections and bolts for attaching said terminals to the rails, and a wire connecting the terminals.

**454,815. Electric-Light Hanger;** George Wells Smith, of Union City, Ind. Application filed Jan. 22, 1891. In an electric



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lamp hanger, a block secured to a suitable support, levers pivoted upon the said block, hooks at the lower ends of the said levers arranged to support a lamp, and contact arms pivoted to the said levers to hang over and close to the hooks of the same.

**454,816. Electric Circuit Closer;** John H. R. Ward, of New York. Application filed Jan. 8, 1881. An electric circuit closer consisting of a cylinder, movable rectilinearly and angularly, having a spring acting in opposition to the rectilinear and angular motions and two electric contact terminals, of which one has a roller pressing against a rectilinear guide, a spiral guide leading from said rectilinear guide, and from one end of said cylinder toward the other end, an angular guide leading from the upper end downward toward a stop, and at such distance from the spiral guide as to leave room for the passage of said roller.

**454,818. Electrode for Secondary Batteries;** Boyd Anderson, of Texarkana, Tex. Application filed Sept. 29, 1890. A secondary-battery element constructed of two perforated plates, each having transverse flanges on three edges of one face, corresponding flanges on said plates being secured together to unite the plates and form a central recess open at the top, said central recess being filled with an active material, and said opening at top being closed by a suitable tamping.

**454,832. Electromagnetic Clutch;** Erastus S. Bennett, of Denver, Colo., and Horace F. Parshall, of Baltimore, Md. Application filed July 29, 1890. The combination, with the coil of an electromagnet, of a core provided with a series of radially disposed arms having their ends bent into a position substantially parallel with the sides of the coil, and an armature having radially disposed arms adapted to rotate opposite the ends of said radial arms to be influenced thereby.